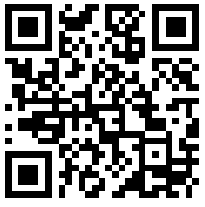

The Book of Knowledge

The Children's Encyclopædia

EDITORS-IN-CHIEF

ARTHUR MEE
Temple Chambers, London

HOLLAND THOMPSON, Ph. D.
The College of The City of New York

With an Introduction by

JOHN H. FINLEY, LL. D.
President of The College of The City of New York

DEPARTMENTAL EDITORS AND CONTRIBUTORS

All Countries
FRANCES EPPS

Natural History
ERNEST INGERSOLL

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CONTENTS OF THIS VOLUME

This is a short guide only to the principal contents of this volume. It is not possible to give the titles of all the Poems and Rhymes, Legends, Problems, colour pages, questions in the Wonder Book, and many other things that come into the volume; but in all cases are given the pages where these parts of our book begin. The full list of these things comes into the big index to the whole work.

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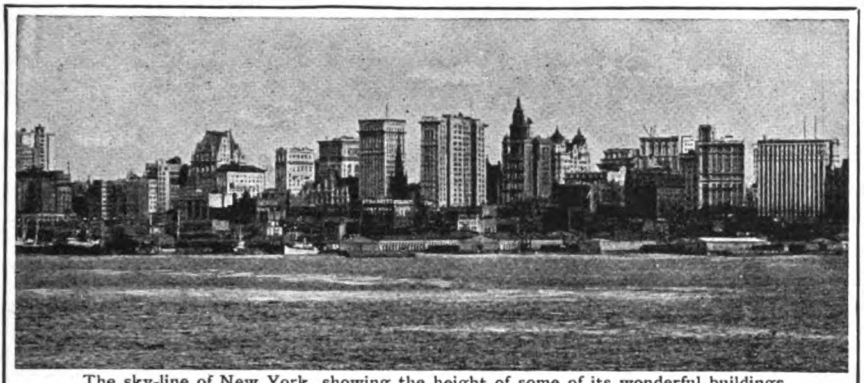
THE HISTORY OF OUR LAND



The sky-line of New York, showing the height of some of its wonderful buildings

THE UNITED STATES TODAY

CONTINUED FROM PAGE 2422

In the last article we began to tell something of the products of our land and mentioned the chief crops raised upon the farms. We mentioned also the fruits of various kinds. In short we spoke of what may be called vegetable products, as they all belong to the vegetable kingdom.

There is one more important vegetable product which you have probably never considered a crop. Yet it is just as truly a crop as hay. The only difference is that it takes longer to grow. This crop is trees and the product is wood, or lumber. A hay crop grows every year, and perhaps several times a year. A crop of trees takes twenty, forty, a hundred years to grow. Otherwise they are alike.

MUCH OF OUR COUNTRY ONCE COVERED WITH TREES

When our ancestors came to this country, much of it was covered with trees. The earliest descriptions and pictures of Manhattan Island show us that it was once covered with a great forest. So was most of New England and the whole Atlantic Slope in fact. A part of the Mississippi Valley had no trees, but was covered with waving grass. This is the prairie region, of which you have heard, and there are more trees in it now than there were a hundred years ago. There were, however, great forests about the Great Lakes, in the Rocky Mountains, and on the Pacific Coast.

In another place we shall tell you how these great forests were cut down and much of the wood was wasted, because people thought there was enough to last for ever. We are now, cutting down our trees three times as fast as they grow, and soon they will be gone unless men begin to plant trees in great numbers. Think what uses we make of trees and their products, and you will see how inconvenient it will be to find something to take the place of wood. More lumber is cut in the United States than in any other country in the world.

THE ANIMAL PRODUCTS OF OUR COUNTRY

Now let us study a little some products of our country of another

sort, the animal products. You have roast beef for dinner sometimes and you know the animal that furnishes it. Perhaps, if you live in the country or in a small town, you have a cow or several cows in the barn, and you know that farmers raise cattle for the butcher. But where does the meat for the great cities come from?

You have perhaps read of the great cattle ranches of the West. There were many of them a few years ago which included thousands of acres. In other sections were millions of acres of government land over which cattle ranged, living out of doors all winter.

As the population increased much of this land has been needed for farms, and the great ranches are being broken up. So many cattle can no longer get their living all the year by grazing, but must be fed a part of the year. Every year beef is becoming higher in price.

American meat sold in every land

Nevertheless the United States is still the chief beef-producing country of the world. We send thousands of animals alive to Europe. In many of the western cities are packing houses where the animals are slaughtered and prepared for market. The meat is stored in cold rooms, and when cold is carried in cold cars all over the United States and in fact all over the world. Many million pounds are also sent in cans.

The humble hog, however, furnishes a larger value than any other animal. Our country stands at the head of the producers of pork and pork products, which are also sent over the world.

In nearly every state sheep are raised both for food and for their wool, but the greatest number are in the western states, though Ohio has a large number. In the production of wool our country ranks third. Australia is first, the Argentine Republic is second, and Russia is fourth. We cannot send any wool abroad but must buy in great quantities in order to get enough to clothe our people.

Poultry and eggs form a valuable product

You would hardly believe that poultry and eggs are among the most valuable products of our country. Yet it is estimated that two hundred eggs are used in this country, every year, for every man, woman and child, and the value is very great. We produce just about enough for ourselves and have few eggs to send away.

The same is true of butter and cheese though we do send away a little cheese. The value of these two articles of food is more than $140,000,000 a year. Of course, the value of the milk sold in our towns and cities is many millions more. Some of this you know is put into cans and sent abroad.

The American mule pulls wagons in Africa

We also raise many more horses and mules than we need and these are sent to Europe and even to Africa and Asia. The mule eats less than a horse and will keep strong on coarse rough food on which a horse would starve. During the South African War, thousands of American mules were bought by the British to pull the supply wagons.

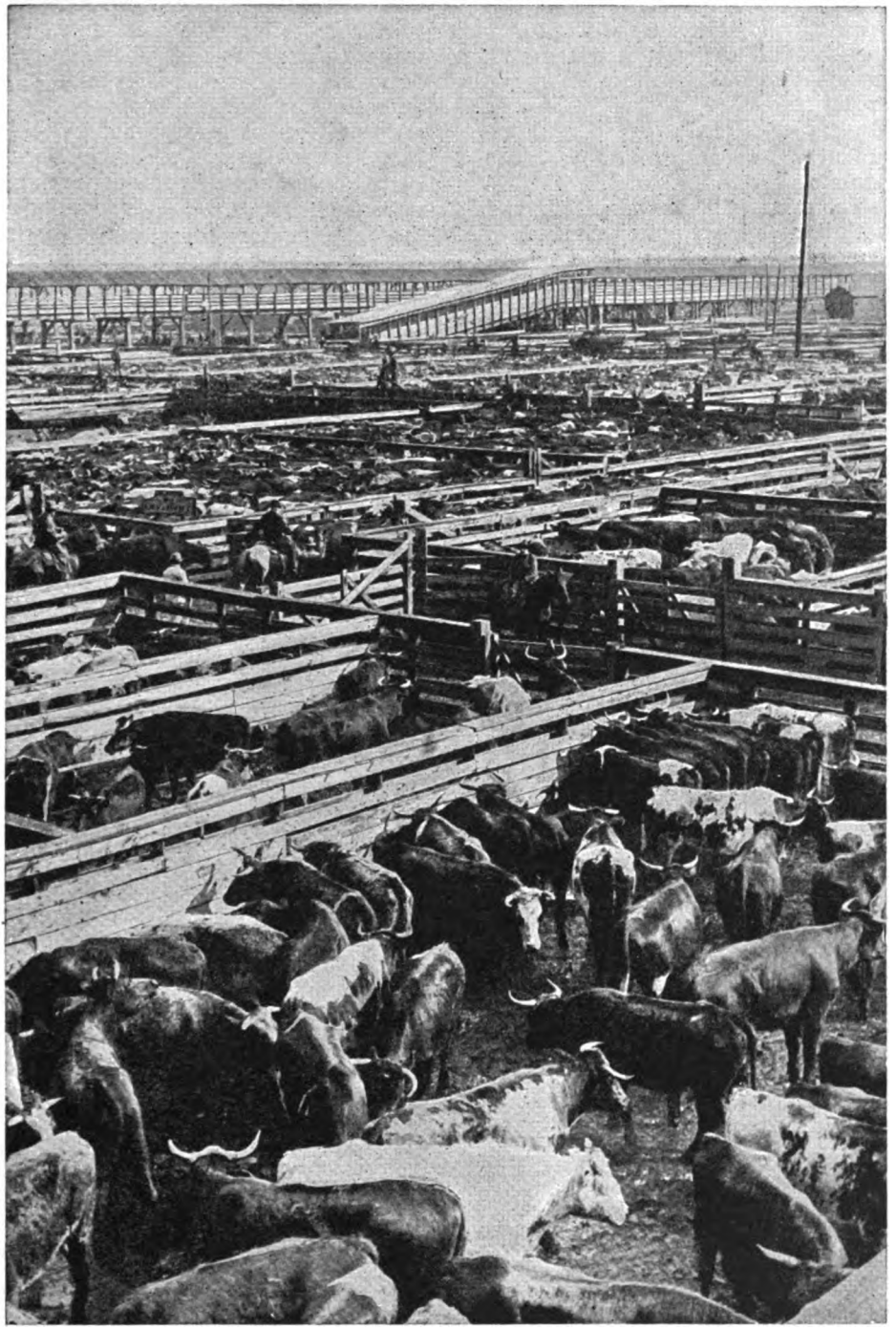
While the sea is not precisely the United States, yet the food gotten from the water is a part of our national wealth. Our fishermen get just about one-fifth of all the fish caught in the world, and send away great quantities of salmon, which are nowhere else so plentiful as on the western coast of North America. We produce more than four-fifths of all the oysters eaten in the world, and no other oysters are so good.

In order to be certain that the fish will not be caught faster than there are new ones to take their places, the government has built fish hatcheries many places on the coast. Here the eggs are hatched, and after the little fish are large enough to take care of themselves, they are turned loose in the streams and in the sea. You have learned in another place how some fish eat the eggs of other fish.

Our mineral products

Now we come to the third great class of products, which belongs to the mineral

THE GREAT CATTLE-YARDS OF CHICAGO



Chicago is the world's greatest stock market. It is a huge, wealthy Illinois city on Lake Michigan, and cattle from a thousand miles around are sent to its great stockyards, one corner of which is shown in this picture. These stockyards, or markets, cover 574 acres of ground and give employment to 1,800 workpeople. Many thousands of men and women are employed in the meat industry in Chicago, the most important centre of this trade in the whole world. Seventy years ago Chicago had only one or two houses; now it has over two million people.

kingdom. In minerals the United States is very rich. In fact the value of our production is almost equal to that of all the rest of the world put together, though this will not be true when the great stores of Russia, China and Canada are really opened. Mineral products are divided into metals and non-metals.

The most valuable of all our metals both in usefulness and in money is iron. Our country furnishes about one-third of the iron of the world, and more than one-third of the steel, which is made from iron. We shall tell you more of how iron is gotten from the ore and how it is then turned into steel in another place. Three states, Minnesota, Michigan and Alabama, furnish the most of the iron ore in this country though some is found in about twenty-five states.

OUR COPPER WORTH MORE THAN OUR GOLD

Next in value to iron is copper and of this we furnish about half of the world's supply. Copper is used for many things, but perhaps the most important use is as a conductor of electricity. Nearly all the wires you see over which electricity passes are of copper, and it is also used in electrical machines. Much of it is also used to cover ships, as it is strong for its weight and the water does not affect it very much. Montana furnishes the most, and if we add what is mined in Michigan and Arizona, we have nine-tenths of our production.

Next in value is gold, of which we furnish between one-fifth and one-fourth of all mined in the world. South Africa is first, of course, and then comes our country. In our production Colorado has fallen to second place, for California has taken first place again, and Alaska comes third.

TWO METALS USUALLY FOUND TOGETHER

The next two metals are almost equal in value and are almost always found together. These are silver and lead, but in most years the silver is worth a little more than the lead. We produce about one-fourth of the silver of the world, which puts us in second place, for Mexico stands first. Montana is first, Utah second, and Colorado third among our states in the production of this beautiful metal which has so many uses that you can name.

Lead is used for many purposes, both pure and when mixed with some other metals. Water-pipes and tanks, electric batteries and bullets are all made of lead. When mixed with tin it makes solder, with which the plumber stops the leak in the pipes; mixed with another metal, called antimony, it forms the type metal from which this book is printed. We produce more than any other country — about one-fourth of the yearly supply. Spain, the German Empire and Mexico also furnish large quantities of this metal. In our country Colorado is again first in its production.

A METAL SELDOM USED ALONE

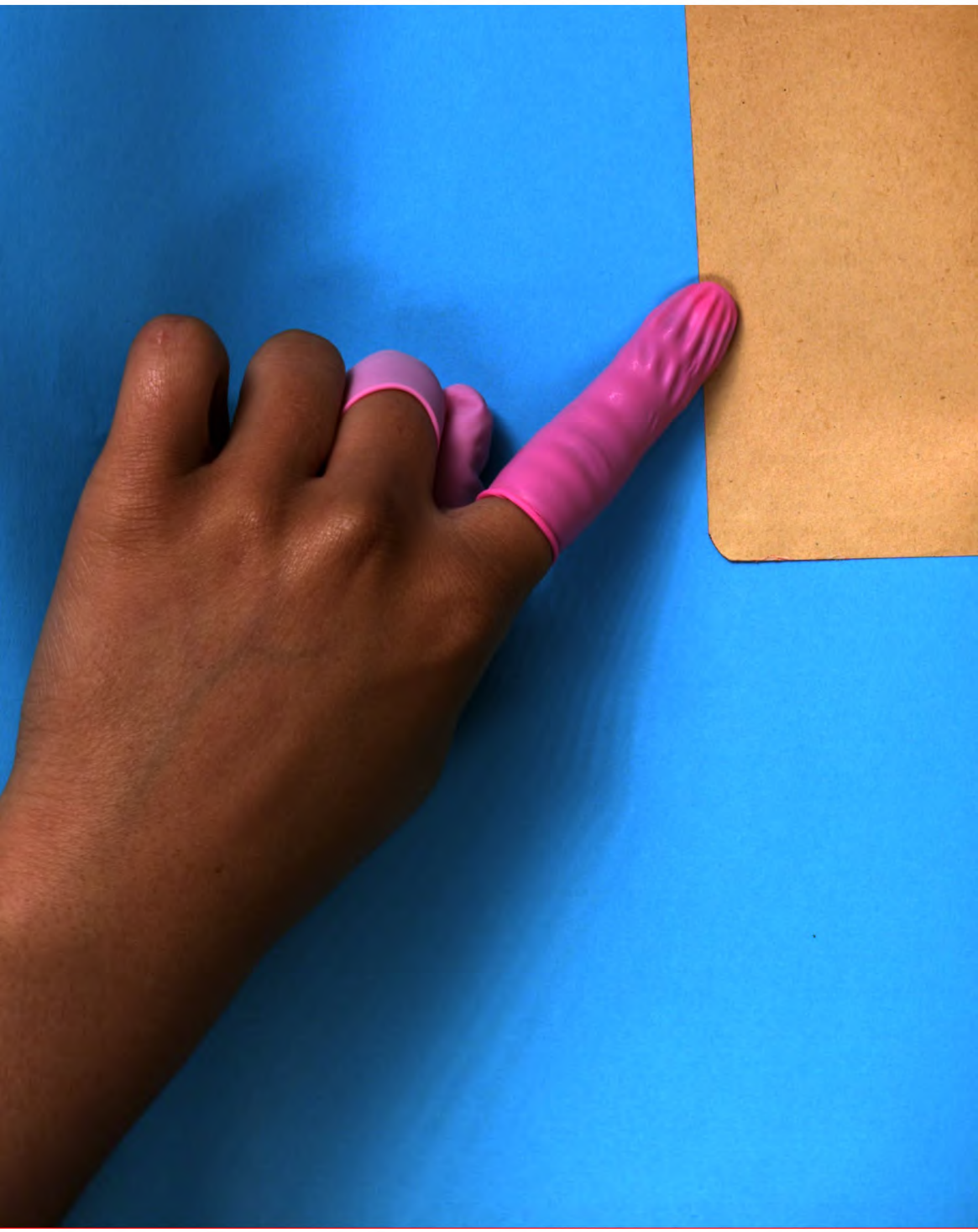
Zinc is used to cover iron to prevent it from rusting, making what is called galvanised iron. Mixed with copper, it makes brass which is very useful. Much is also used in the manufacture of paint. We produce about one-fourth of the world's supply.

Perhaps you have seen a white metal something like silver but much lighter in weight, called aluminum. This metal is never found pure, but it is one of the most abundant elements in the earth's crust. Most clays contain it, and in combination with other substances it forms beautiful gems in the earth. An American discovered a cheap way of separating it from the substances with which it is combined, and now we produce about half that is used. This metal is likely to be much more freely used in the future, as there is much more of it in the earth than there is of iron, and the price is going down.

The only other important metal is quicksilver or mercury, which you see in thermometers, and which is also used in medicine and in gold mining. More than a quarter of the supply comes from the United States, nearly all of it from California.

MINERALS THAT ARE NOT METALS

Many things which are minerals are not metals. The most important of these is coal, of which we produce



between one-third and one-half of all that is mined, or almost as much as Great Britain and the German Empire together. These three produce most of the coal used, though in Russia and China there are great beds which are hardly worked at all.

Next in value is petroleum, of which we furnish much more than half of all that is produced, with Russia second. Besides kerosene, gasoline, vaseline and paraffin, many other valuable products are obtained from this oil. It is found in Pennsylvania, Ohio, Texas, California, Indiana, Kansas and many other states. Along with oil is almost always found natural gas, for which wells are bored just as they are for oil. Many cities and towns in the United States are lighted and warmed by this fuel, which is conveyed by pipes like ordinary gas. In another place we shall tell you more of how this great help to mankind is produced.

Building Stone of Many Kinds

Next in value of our minerals is building stone. Some sort is found almost everywhere, and we have some of the most beautiful stones in the world. Marble, limestones and granite are the ones chiefly used, and many different colours are to be found among them.

Salt is produced all over the world and though the United States makes more than any other nation, — about one-fourth, — we do not have enough for our needs. You are told about the production of salt on page 223.

Glass, about which you are told on page 1173, is, you know, only melted sand. No other country makes so much as we do, for nowhere else are there so many people who can afford to buy glassware for their tables, and to use so much glass in their windows.

Some Other Minerals Found in Our Country

There are dozens of other useful minerals found in the United States. Phosphate rock, used for fertiliser, is valuable, and so is sulphur. Grindstones are worth many thousands of dollars, borax is valuable, and so is mica, much used for stove windows, and other purposes as well. We must not forget the rock from which cement is made for this grows more valuable every year.

We must acknowledge that Nature has been kind to our country. No other country has such a variety of soil on which so many different kinds of crops can be raised. In no other country do so many animals thrive, and no other country is so rich in mineral wealth. If the United States were shut off from all the rest of the world, it would not make very much difference. We would have to do without some things but they would not be very important.

What are Raw Materials?

It is usual to speak of most of the things of which you have been told above as food products and as raw materials for manufacturing. For example, cotton is the raw material and cloth is a finished product. Iron ore is a raw material, steel rails for a railroad are a finished product. Of course, however, you must remember that the finished product of one factory may be raw material for another. Cloth, for example, is the raw material for a tailor.

The United States has become the greatest manufacturing country in the world because it has the greatest stock of raw materials, and because it has cheap coal and much water power. You must remember that power is necessary to run machines, and no matter how much raw material a country has, it cannot become a manufacturing country unless it can get some sort of power to run its machines, and has also a cheap way of carrying raw material to the factories and of taking away the finished goods.

You have already been told of the coal supply of our country, and that it has many swiftly running streams. These streams are made to furnish power by means of water-wheels. Because New England had so many of these streams is one reason why manufacturing developed early in that section.

How the Streams have been Harnessed

Lately there has been a great increase in the use of electric power. On many streams, particularly in the South, great dynamos to develop electric power have

been built on the banks of streams. This power is then carried by wires ten, twenty, fifty miles away to places where there are railroads to carry the goods, or where there is a good supply of labour. In many factories, instead of great engines to run the machines you will see only an innocent looking wire running into one corner of the building. And yet this wire carries more power than any number of great engines can develop.

How labour and skill add to value

Labour and skill add very much to the value of some kinds of raw material. For example, a lump of iron ore costs almost nothing. If made into pig iron it is worth a little more; made into a stove it is worth still more; made into steel for railway rails the value increases. The same amount of material made into knife blades is worth a great deal, and then if made into springs for watches, say, is worth many hundreds of dollars.

A pound of raw cotton costs only a few cents. When made into coarse thread the value increases greatly, and when this thread is woven into cloth the value becomes greater still. Or if the cotton is spun into fine thread and then made into lace, the value may be a thousand times as much as that of raw cotton.

Other raw materials not much increased in value

Some other raw materials are not increased so much in value because not so much labour and skill is spent upon them. A loaf of bread does not cost so much more than the wheat out of which it was made, but even here fine pastry and cakes are sold for much higher prices.

The United States was, at first, as you have been told, almost entirely an agricultural country, but since your fathers were born, it has become also the greatest manufacturing country in the world in the value of products.

We do not yet make the finest goods of every kind, for some of them require very highly skilled labour which requires a long time to train, but every year finer and finer goods are made. In some lines we already surpass any other country, while in others we make only the coarser grades. On some goods you see foreign names, or perhaps "Made in Germany." Sometimes these goods are sold in this country because of quality and sometimes because of cheapness.

Our most valuable manufactures

Of all the manufactures of the country those of the greatest value are the food products. These are flour, meal and meat prepared for use, and similar things. These amount to more than thirty dollars for every man, woman and child in the country. They are important because without them we could not live. Minneapolis is the chief centre of the flour, and Chicago of the meat industry.

The next group to be mentioned is that of iron and steel and their products. The chief single item in this group is steel rails for railroads, either steam or electric. We make all our railroads need, and in far away parts of the world you will find engines running on American rails. Pennsylvania is the chief state in such manufacture.

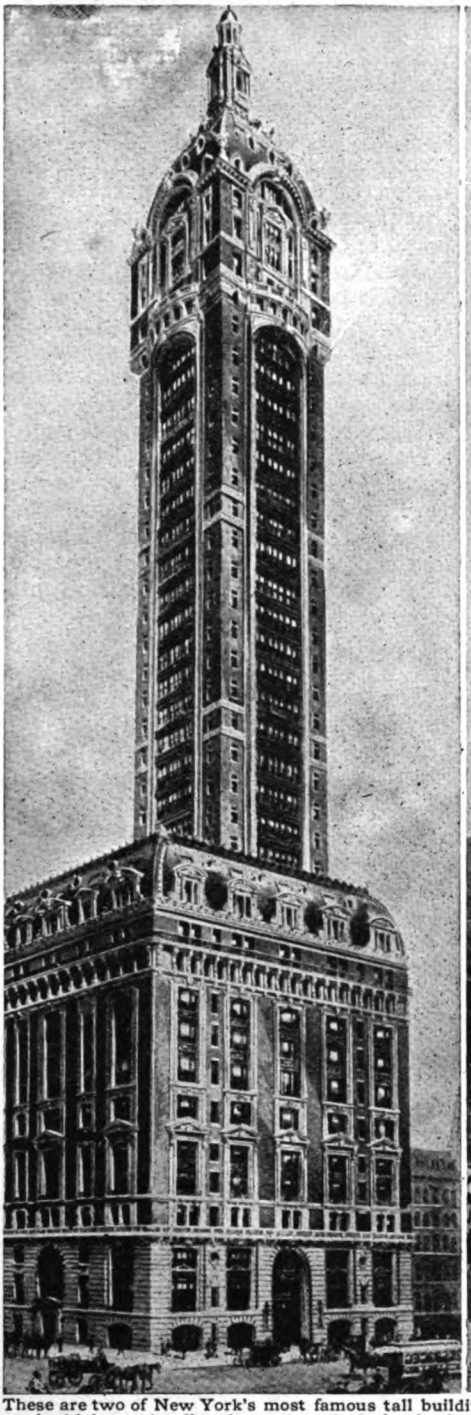
Much of the steel sent abroad goes in the form of electrical and agricultural machinery. Our country is the chief maker of all sorts of farming machinery, about which you may learn in another article. Some of the steel goes into the making of ships though we are not the greatest ship-building country.

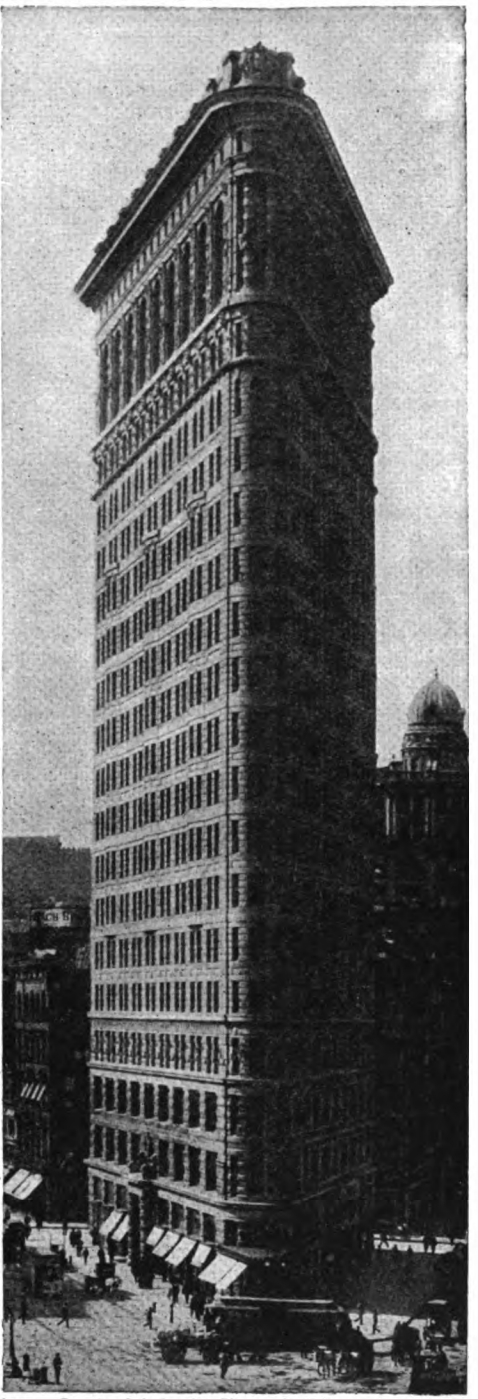
Cloth of many kinds

The next group of our manufactures is the textiles, which means, that which is woven. We may divide this group into wool, cotton, silk and linen. Then besides there are other classes made up of a combination of two of these. Our woollen manufactures are large but we send very little abroad, as we need most of our production for our own people. Besides cloth there are carpets, stockings and knit underwear, and the like.

We make more knit goods than all of the rest of the world put together, and we make more carpets than any other country. More knit goods are made in New York State than in any other, while in carpets, Philadelphia holds

TWO OF THE WORLD'S HIGHEST BUILDINGS





These are two of New York's most famous tall buildings. On the left is the Singer building, about forty stories high, much taller than any cathedral spire in this country. The other is a corner building which Americans have aptly termed the "flat-iron," because the front of it is narrow and the back broad. In some of these buildings as many as 10,000 people work, and the crowds going in and out make the place look like a railway station. There are stairs to the top, and elevators running all day and sometimes all night, some of them "expresses," going without stopping from the street floor to the twelfth, sixteenth, or twentieth story.

first place. Taking all kinds of woollen goods together, Massachusetts is the first state.

We manufacture much cotton goods though we do not use as much as half our crop of the raw cotton. This industry is almost entirely confined to the Atlantic states. The first cotton mill was built in Massachusetts about 1790, and for many years nearly all the mills were in New England. For about thirty years the number of mills in the South has been increasing, and now the Southern states use more cotton than the Northern.

Massachusetts is still the chief state, with North Carolina second, South Carolina third and Rhode Island fourth. We send much cotton cloth to other countries, and some day will probably manufacture a much larger share of our cotton.

Our silk manufactures

Our country uses about one-third of the raw silk of the world, but still we do not manufacture all we need. No other country uses so much silk as the United States, because no other people can afford to buy so much. The leading state in silk manufacture is New Jersey, with Pennsylvania next. The city of Paterson, in New Jersey, is one of the chief silk manufacturing cities in the world.

Though we grow very little flax for spinning we bring in a great deal to be woven into cloth. The best linens are not made in the United States, however, but we make a great deal of linen crash for towels, besides much linen thread. Some flax is also mixed with cotton and very often the product is sold by dishonest merchants as pure linen. Ireland, Holland and France are the great linen countries.

The next group of our manufactures in value are those of wood. We help to supply the rest of the world with these, besides our own country.

More treasures once thrown away

Next in value is the group known as chemicals, drugs and dyes. This includes fertilisers of many kinds, which furnish food for plant life, medicines made from our native plants or from plants imported from other countries, many kinds of dyes and similar things. We told you in a former volume how the cotton seed was once thrown away. Around gas works and oil refineries only a few years ago there was such a great quantity of a sort of tar left after the gas and oils had been taken out, that it was in the way. Chemists have found in this ugly black substance more hidden treasures. Some of the most valuable medicines used by our doctors are now gotten from it, as well as brilliant dyes. The value is many million dollars, from a substance thought almost worthless.

When speaking of our mineral wealth a little while ago, we spoke of the great value of our copper mines. For the year 1910, the copper manufactures, sent abroad, were worth half as much as the iron and steel we ship. A large part of this is in the form of electrical machinery.

Paper and printing

The next of our manufactures in value is paper, or at least paper and printing. About ten dollars worth for every man, woman and child in the country is manufactured every year. When you think of the number of newspapers, magazines and books, the amount of wrapping paper used by the butcher, the grocer and other tradesmen, to say nothing of the number of paper bags used every year, you can easily see how it happens that the value is so great. Then, also, there is paper for writing. Besides, too, there are hundreds of other uses for paper, of which you have probably never heard.

Now we come to leather, as the prepared skins of animals are called. When the skin is removed it soon becomes dry and hard, so hard that it cannot be used for shoes or other purposes. So it must go through many processes to make it soft. We cannot stop to tell how this is done now. The chief animals, the skins of which are used, are cattle, sheep, hogs, goats and horses. We make very little horse or goat leather in this country. In all we make nearly a third of the world's leather.

The number of carriages, wagons and automobiles is very large and the value is very great, but a part of this value is in the wood and steel already spoken of. Then there are the alcoholic liquors, of which the value is large. Tobacco, too, sells for many millions of dollars. We grow not quite half of all grown in the world. Of this half is used here and half sent to other countries.

There are many other things manufactured in this country which we have not space to mention. Nearly every little town in the states east of the Mississippi has one or more mills or factories of some sort, and there are many in the states west of the great river.

STRANGE THINGS THE CENSUS SHOWS US

We learn some curious things if we study the long columns of figures that are sent out from the Census Office in Washington. We find that New York State makes ninety-nine out of every hundred collars and cuffs made in this country; that Connecticut makes about sixty-five out of every hundred clocks, and more than half of the brassware.

Now when we learn that a country does much manufacturing, we know that it must have easy ways of getting raw material, and of sending away what its factories make. In Holland you were told that more goods are carried by canal boat than by railway. In many other countries a very large part of all the freight is carried by river or canal.

Though the United States has many rivers, not very much use is made of them as the railroad is quicker. About half of all the miles of railroad in the world is in the United States. Including all sidetracks and the like, the number of miles is more than 300,000.

Some of these railroads run from the Atlantic to the Pacific under one management. You can go from New York to New Orleans without changing cars. The passenger cars on these trains have every convenience and one can go from New York to San Francisco in less time and with less fatigue than the journey from New York to Boston required a hundred years ago. No other people travel so much. If all the distances travelled by passengers in the United States were divided equally it would amount to a journey of two hundred and fifty miles a year for every one of us.

WHO ARE THE PEOPLE OF THE UNITED STATES

From the first settlement of the United States there has been more work than there have been workers. In the earliest days, when land was free to all, few people would work on the farms of others when with a little trouble they could get farms of their own. After the Revolution all the unoccupied land became the property of the government, and you have been told how possession of the land beyond the Mississippi was gained.

This land was first sold at a very low price to settlers and later the government gave a farm to every man who would work it. The free land is not quite all gone yet.

Now what of the people of our country? You were told in the third volume that besides the English, some Scotch, Irish, French and Germans came to this country before the Revolution. For a time after the Revolution very few foreigners came, but after 1830 the number became larger, but not so many as 100,000 came any year until 1842. Until 1860, nearly all who came were from Great Britain, Ireland and Germany. Since the Civil War the number has increased very greatly, until now nearly a million come every year. Not so many now come from Great Britain, Ireland, Germany, Norway and Sweden or any other countries of Northern Europe.

Now the immigrants come from Central or Southern Europe. Russia, Austria-Hungary and Italy furnish the largest numbers. Some come to escape persecution, some to improve their condition, some to avoid military service. Some come intending to spend their lives, while others expect to work a little while, save their money and go back to their native land. Most of them come first to New York, and as they enter the harbour one of the first things they see is the great statue of Liberty with her torch upraised, as a sign that here in this land every one has a chance to make of himself as much as he can.

They are of many races and speak many different languages. They have not been used to free government and many of them are very poor. They are willing to work, however, and to do the kinds of hard and dirty work, which

THE STATUE OF LIBERTY

On a little island in the middle of the harbour in front of New York towers this magnificent Statue of Liberty, over 300 feet high greeting the visitor to the United States. The statue itself is 150 feet in height, and was presented to the United States by the French nation in commemoration of the 100th anniversary of the Declaration of Independence, and to show how much they admired the freedom of the American nation. It is made of copper and iron, and the torch held aloft is lighted at night by electricity.

the native-born American does not like to do.

Their children go to the public schools, learn to speak English, and many of them go on to high school and college. In New York City are many large merchants and manufacturers who came to this country poor immigrant boys. Some well-known doctors and lawyers are the sons of parents who never learned to speak English.

You have learned something of what the American has done in the past in the History of Our Land. In other parts of our book we tell you of the famous writers, inventors, painters and sculptors, and so shall not stop to speak of them here. But no mention of America is complete without speaking of the American's belief in education. No other country spends so much money on its schools. In every state of the Union are public schools open free for every child, and many states offer a high school besides. Some states support free colleges and universities for their young men and young women.

Where the colleges and universities are not supported by the state, rich men have given many millions of dollars for buildings and to pay the salaries of the professors. These wonderful gifts astonish the European, for nowhere else have men of wealth been so liberal. They have also given large sums to establish public libraries, build art galleries and museums, and to found institutions to study scientific and social subjects.

THINGS IN WHICH OUR COUNTRY IS NOT FIRST

As I look back over this article, I fear that it sounds boastful. Perhaps it is, for I have preferred to tell you of the things in which our country has been most successful. But there are other things in which we are not at the head of the world. In music, art and literature we are not yet in the first rank. In obedience to the law and respect for the rights of others, many nations surpass us. Our politics are not always clean. We can only hope that as the years go on we shall improve, and every one of us should do his part to make our country a better place in which to live.

Some one has called America "the melting-pot of the world." By this he meant that in our country people of different races, different languages, different religions, and different ideas of life, are living here together, and out of all the confusion will some day come the future American.

AMERICAN INVENTORS AND INVENTIONS

WAGES are higher in the United States than anywhere else in the world. The reasons for this we cannot discuss here, but the fact has brought many immigrants.

WHAT FOLLOWS HIGH WAGES

Where wages are high, employers will try to get their work done with as few workmen as they can, and this is one of the reasons why the United States is ahead of the world in labour-saving machinery. Though the machines may cost a large amount of money, they often pay for themselves in a few years, long before they are worn out.

In England wages are lower than they are in the United States, and therefore we find many things done by hand in England which here are done by machines. In India wages are still lower and there we find very little machinery.

ONE OF OUR FIRST INVENTORS

One of the first of our inventors was Benjamin Franklin, about whom you can read in another place. Born a poor boy in Boston in 1706, he became the companion of princes and the friend of the greatest men of his time. When still a young man he improved the printing press, and though these Franklin presses would now be considered so slow that no one would think of using them, they were better than anything before them.

Of his discoveries in electricity you are told on page 2116. The lightning rods you now see on barns or houses in the country are his invention, made in 1752. Another was a stove in 1742, intended to save a part of the heat, which went up the chimney from the open fireplaces. Many thousands of them are still in use.

You have also been told of the invention of the cotton gin by Eli Whitney in 1793. This machine is one of the most important inventions ever made, and is one of the few machines which have been very little improved since first shown to the public. It made cotton growing profitable, and slavery, which seemed to be dying out, became so firmly fixed in the cotton-growing states that only a great war and the sacrifice of hundreds of thousands of lives could drive it out.

THE FIRST SUCCESSFUL STEAMBOATS

In another place you have been told of Robert Fulton and his steamboat, the Clermont. Fulton was not the first person to build a steamboat, as you know, but he was the first person to run one successfully, and the trip from New York to Albany, in 1807, marked the beginning of the steamships of the present day. You can see that a sailing ship could not always be used on a river if the wind blew the wrong way. A steamship can be used at all times.

It seldom happens that an invention is the work of one man. The first man gets an idea but he cannot quite make it work. Another makes an improvement, and then another, and finally some man using the work of those who have gone before, reaches success.

IMPROVEMENTS IN FIREARMS

Now American rifles, shot-guns and revolvers are among the best in the world, but no one man has done this. As early as 1811, a man named G. H. Hall made a gun which could be loaded at the breech, as the end of the barrel next to the wood is called.

In 1830, Samuel Colt invented a new form of pistol which could be fired several times. In 1835 he improved this by making the part containing the cartridges revolve, and so the weapon was called a revolver. He began to manufacture them and his factory grew to be one of the largest of its kind in the

world. In this case a large fortune was gained by the inventor himself.

THE PROFESSOR WHO INVENTED THE TELEGRAPH

You have been told something of the invention of the telegraph by Professor S. F. B. Morse. He was born in Charlestown, Massachusetts, in 1791. His father, Reverend Jedediah Morse, was one of the first American authors of text-books and sent his son to Yale, where he had himself graduated. After young Morse graduated he went to Europe to study art and remained several years. He came to New York in 1815, and was successful as a painter. After another stay in Europe he became professor in the University of the City of New York. One of the other professors was lecturing on electricity, then not very well understood, and in 1832, Professor Morse got the idea of the telegraph, and in 1835 succeeded in his experiment in one of the buildings of the University.

Some improvements were made and in 1838 he asked the United States Congress to build a line from Washington to Baltimore to see how it would work over long distances. Most people laughed at the idea and Congress did not vote the money. He then went to Europe to try to get some foreign government to give him the money, but was unsuccessful there also. He continued working on his invention and trying to get money to build a line, but without success. Finally, when he was just about to give up, Congress on the last day of the session, March 3, 1843, voted $30,000. With this the line was built and on May 24, 1844, the message "What hath God wrought?" was sent from the Capitol at Washington to Baltimore.

HOW GRAIN WAS CUT IN THE EARLY DAYS

In the early days of our country grain was cut with a sickle, a picture of which you may have seen. It was in shape much like the "question mark," which is put at the end of some sentences. A man seized a handful of the grain in one hand and cut it off with the sickle. Next a "cradle" was used. This was a long curved knife at the end of a handle, with wooden fingers which kept the grain from falling.

Two men were working on a new machine to cut grain at the same time and both received patents in 1833 and 1834. The more successful was the machine of Cyrus Hall McCormick. This machine, which was drawn by horses, cut more than many men could do by hand. At once others began to try to improve this machine, and just before the Civil War, John E. Heath invented a machine which not only cut the grain but tied it into bundles, thus saving much more labour. Now to some of these machines a threshing machine is added, which separates the grain from the chaff, as it is drawn along.

OTHER IMPROVEMENTS IN FARMING MACHINERY

There have been many other improvements in agricultural machinery. You remember the picture of the plough used in the Philippines, which is little more than a crooked stick. Only a little more than a hundred years ago, such ploughs were common in this country, though the point was covered with iron. In 1797, Charles Newbold, of New Jersey, invented an iron plough, but the farmers would not use it as they feared that the iron would poison the soil. Besides it was very heavy and expensive. Jethro Wood, in 1819, invented an iron plough made in several parts so that if one broke it could be replaced without trouble, and this came into common use. Then the plough was put on wheels and instead of holding the handles, the farmer has a comfortable seat and drives the horses. On the great farms in the West, many ploughs are pulled by an engine.

Only a few years ago all hay was raked by hand. Now a horse-rake does as much as twenty or thirty person could do, and when the hay is partly dry, a tedder scatters it, so that the sun can reach every blade. We have also machines which sow the seed and then cover it up. There are machines to gather corn, to husk it, and separate it from the cob. If corn had to be separated from the cob by hand, it is said that it would take all the people in the United States one hundred days a year to do this work.

SOME INTERESTING FIGURES

Some one has calculated that now it takes on the average only ten minutes of labour to grow a bushel of wheat, while fifty years ago it took three hours. It takes forty-one minutes of labour to grow a bushel of corn while then it took four and a half hours. A hundred years ago about three-fourths of the people lived on farms. Now something less than one-third are able to raise food enough for the whole population and have some to spare for other nations. The chief cause of this is the invention of farm machinery.

Another important invention was that which made possible the use of rubber. Rubber, which is the sap of a tree, was kno vn to the natives of South America before the discovery of America, but was unknown in this country until 1800, when some was brought by a sea captain. The natives of South America made clumsy shoes of it, and some were sold in the United States. In 1831 some men tried to make rubber cloth, but did not succeed, as it melted and stuck in summer, and cracked in winter.

THE MAN WHO FOUND OUT ABOUT RUBBER

Charles Goodyear, who was born in New Haven, Connecticut, in 1800, was a hardware merchant, but was not successful. He became interested in rubber and tried many experiments. It is said that in 1838 or 1839, he accidentally dropped some rubber and sulphur on his kitchen stove and found that he had by chance succeeded in doing what he had failed to do by experiment. This process is called vulcanisation, and was the beginning of the rubber business.

We use rubber so much now that it is hard to understand how people ever got along without it. Millions of pairs of boots and shoes are made every year. Rubber blankets and rubber coats are much used; hot water bags and cushions take thousands of pounds, and much is used to make rings to seal jars and bottles. Pencil erasers, tennis balls, and rubber stamps also require a great deal.

During the past twenty years, millions of pounds have been used for tires for motor cars and other vehicles. One can hardly think of the motor car with iron tires, and every year more carriages are fitted with rubber tires, to say nothing of bicycles. These are only a few uses of rubber. You can name dozens of others yourself.

Mr. Goodyear and his brother, who was also interested, next began to try to make rubber hard. They were successful in 1851 and now combs, buttons, bottles, inkwells, penholders, fountain-pen barrels and many other things are made of hard rubber. Mr. Goodyear seems to have been a poor business man, and though he took out sixty patents on his inventions, he did not gain much money and died a poor man.

SLEEPING CARS A RECENT INVENTION

In this country distances are so great that it is often necessary to spend a night on the train. Once people had to sit up in the uncomfortable seats and try to sleep in any way they could. Now one can have a good bed, and many persons sleep as well on the train as they do in their own homes. The first car arranged for sleeping was planned by a man named Woodruff in 1856, but it was not very comfortable. In 1863, George M. Pullman built a car on a new plan which could be used as an ordinary car during the day, and arranged for sleeping at night. It was much superior to anything ever known before, and now Pullman cars are used on every railroad in the country, and one can go quite comfortably from Boston to San Francisco. Mr. Pullman also invented the method of enclosing car platforms so that one can pass easily from one car to another without danger of being thrown off.

WHAT MAKES HIGH BUILDINGS POSSIBLE

On another page you see some of the high buildings in New York, and buildings like these are to be found in almost every city. Without elevators such buildings would be impossible, as no one could care to climb ten, twenty or thirty flights of stairs several times a day. There are more high buildings in America than anywhere else and so it is natural that the elevators should be better.

The first passenger elevator was in-

vented by Elisha G. Otis in 1853, but has been much improved since.

Improvements on the Railroads

In railways the inventions and improvements made in the United States would fill a large book. One of the most important was the air-brake, made by George Westinghouse in 1869, and improved in 1872. Up to this time trains had only hand-brakes, like those you sometimes see in a street car. This brake was worked by compressed air from the engine and would stop a train when the hand-brakes had little effect.

There are many inventions of which one never hears, that have added very much to our convenience and comfort. Once shoes were divided into two classes, those in which the sole was sewed on by hand, and those in which it was fastened on by wooden pegs or iron nails. The first kind was very expensive and the second kind was stiff and uncomfortable. In 1871 a man named Goodyear invented a way by which the soles could be sewed by a machine. The shoes made in this way were not so good as those made entirely by hand but they were much better than those which had the soles nailed on.

Why We Get Whiter Bread

You were shown, in the story of Bread and Butter on page 1150, the old-fashioned mills where wheat was ground between two stones. In 1875 F. Wegmann, an American of German blood, invented a way of crushing the wheat between smooth steel or porcelain rollers. In this way a larger quantity of flour was gotten from a bushel of wheat, and the flour was whiter.

We use the telephone so much that it is hard to think of a time when we did not have this easy way of talking with our friends or with the grocer or the butcher. You have been told how an American, though he was born in England, invented this instrument. Nearly all the improvements on it have been made by Americans, and now an American, Professor M. I. Pupin, has discovered a method by which he thinks we shall some day be able to telephone across the ocean.

One Man who has Hundreds of Patents

One man has invented so many things that a list of them would fill several pages of our book. This is Thomas A. Edison and we shall give a special article to him and his inventions.

We must mention the type-setting or type-casting machine, which is described under the Wonder of a Book on page 891. This was invented by Ottmar Mergenthaler, and this machine, with some improvements, is used in the office of every large newspaper to-day.

As we have said many times, no one man ever makes a perfect machine. The idea of the automobile is old, for every locomotive is an automobile, but not until the gasoline engine was invented could a motor car which was both light and strong be made. Many men both in Europe and America have helped to make this machine what it is to-day.

America's Share in Conquering the Air

Almost the same thing can be said of flying-machines, except that we can say that there is no doubt that the share of the United States has been the largest. The most credit belongs to Professor S. P. Langley, of the Smithsonian Institution in Washington, though his machine never really flew. But his experiments showed the way and the Wright brothers, Orville and Wilbur, in a small Ohio city, were the first to make machines which would really work. The Wrights have made improvements themselves, and in Europe many machines a little different have been made, but our share in the glory of conquering the air is the largest.

There are hundreds of other inventions of which we might speak. The bicycle as we have it to-day is almost entirely American, the convenient hand camera is also, electric locomotives to pull heavy trains are American, as also is the greatest improvement in weaving machinery. Then too there are thousands of little things which we cannot mention, but enough has been said to show you that American skill and genius have done much for the world.

WHAT THE WISE MAN TELLS US

IN this part of the Book of Wonder the Wise Man tells us many things we have often puzzled our brains about. He tells us why it is that we dream, and says that no dream has any particular meaning, and that all our disagreeable dreams or nightmares merely arise from indigestion or some other disturbance in our system; he tells us why sleep-walkers sometimes walk in the most dangerous places without being hurt; why the moon appears to travel with us when we walk, and why its reflection follows us on the sea; he tells us what makes such pretty dimples in smooth, round cheeks, — angel's kisses, we sometimes call them, but have we ever thought of their natural cause? Moreover, and besides all this, he informs us why we sometimes feel afraid when we do not wish to do so, and why the fear of the dark and of loud noises is so strong in little children.

WHY DO WE DREAM?

CONTINUED FROM 2623

THE brain has many parts, and some part of it may be asleep, while another part is awake and active. That is what happens when we dream. Most of the brain, especially the highest part of it, is asleep in a dream, but parts of it are awake, and these, unguided by the highest powers of the mind, work on the materials of past experience, especially recent happenings. Perhaps only the very deepest sleep is entirely free from dreams, and it seems certain that most of us have dreams of which we remember nothing when we wake.

The more vague and shadowy and the more easily forgotten a dream is, the fewer are the parts of the brain that have been awake; but when we have long and complete dreams, very clear, and very clearly remembered, then it is probable that more of the brain has been awake. The fewer dreams we have, the better it is, for that means that our sleep has been more complete; and if we are to have dreams, it is best to have the kind which are scarcely remembered. *No dream has any meaning about the future.*

WHAT IS A NIGHTMARE?

By far the worst kind of dream is a nightmare—a dream which seems very real, and is intensely horrible or frightening. When nightmares occur often they should be attended to. In some people they are due to heart disease, which prevents the supply of blood to the brain from being smoothly and evenly maintained. But, as a rule, a nightmare has its origin in the stomach, and it is disagreeable because it is aroused by disagreeable sensations in the stomach.

By far the most common of all these causes is indigestion, and everyone who is liable to nightmares should be very careful about what he eats before going to bed. On no account should such a person take anything like a heavy meal less than three hours before going to bed. Besides the unpleasantness of nightmares, we should remember that they mean that the sleeper is not getting sleep of the best quality, and his waking hours will suffer accordingly.

WHY DO WE DREAM WE CAN DO THINGS THAT WE CANNOT DO WHEN AWAKE?

The reason why we seem to do quite impossible things when we dream, and are never surprised at doing them, is that, when we dream, the very highest part of our brain, the part which has to do with our knowledge of ourselves, and with judgment and with the power of distinguishing between what is real and what is only

fancied, is asleep, and so is unable to do its work. When we are awake we may often "build castles in the air," or imagine ourselves doing all sorts of wonderful things; but the highest part of the brain remains active, so that all the time we know well that we are only imagining these things—not really doing them. We know fact from fancy. But when the highest part of the brain and the power of the mind that goes with it are asleep, fancy seems like fact. Sometimes, even in day-dreaming, we gradually pass from the ordinary fancies of a waking person into a state where these fancies seem real; our judging and reflecting powers have "taken forty winks." Probably all stages can be traced, from fancy which we know to be fancy, to the wildest dreams that seem to be reality.

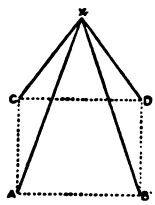
IS SLEEP-WALKING DANGEROUS?

Sleep-walking is a very common thing indeed, though commoner in slight forms than it is in extreme forms. There is nothing alarming in it, and there is no reason to suppose that it does any harm to the walker. It is rather unusual, and that is the worst we can say of it. We need only remember that the best place for the sleep-walker to wake in is his bed, simply because he will not be frightened if he wakes there.

He can usually be persuaded quite easily to go back to bed—for people in his state always readily take suggestions. Their conscious mind is asleep, and does not interfere as it might if it were awake. Of course, it is possible that the sleep-walker may hurt himself, so that he should guard against such chances. Yet the sleep-walker is wonderfully careful; even if he crawls over a roof he will hardly ever come to any harm, unless someone foolishly wakens him, for his conscious mind is asleep, and so he has no fear; and it is fear that makes the danger of many dangerous things.

WHY DOES THE MOON APPEAR TO TRAVEL WITH US WHEN WE WALK?

The moon and other objects in the sky are so far away that as we walk we notice no difference in our position compared with them. The nearer a thing is to us as we move, the more do we notice its change of position compared with ours. We can prove this by comparing the various things we see when we are in a train. The telegraph posts seem to rush past, the fields move past not so quickly, a tree on the horizon almost seems to travel with us, and the moon or the sun *quite* seems to travel with us. It is only when the road turns a little, or the railway curves, that we seem to leave the sun or the moon behind us. The explanation of all this is simply that the eye judges, not by real distances, but by angles. Look at



an object, *X*, from two positions side by side, *A* and *B*; then move nearer to the object and see it from two other similar positions, *C* and *D*. The imaginary lines joining our eyes and the object form the angles *A X B* and *C X D*, and, as we can see, the angle becomes greater the nearer we move to the object or the nearer the object moves to us. Of course, we must distinctly understand what we mean by the size of an angle, or we shall never understand this point. The size of an angle has nothing whatever to do with the *length* of its arms, but with the *width* of the *angle* between them.

WHY DOES THE MOON'S REFLECTION FOLLOW US ON THE SEA?

This is a question that has puzzled many people. It looks as if, wherever we choose to stand on the seashore, the moon throws its light on the water just opposite us, and if we move, the moon alters the path of its light on the water just to suit us. But if two people are together, and one walks and the other does not, they both see the light of the moon in the sea. And if we placed a long row of people all along the shore they would all see a line of light, and they would have to agree among themselves that *the whole of the sea*, and not merely the line of it between the moon and any one of them, was brightly lit up, as a line of it appears to be lit up to each of them. That is, of course, the fact; the whole sea is lighted as brightly as the line we see. As the light strikes the sea from the moon, it is reflected, and passes onwards in the same line, just as a ball does when it is thrown on a smooth surface.

So our eyes catch the light that rebounds from the sea straight to them, and miss the light that is reflected on either side. Move to one side, and

we catch the light we missed before. And so the line of light seems to move, because as we move we see fresh lines of it. The line is broader when the sea is rough, because then many of the little waves are placed at angles, so that they turn the light towards our eyes. In the same way we often see a glint of sun or moon on the water out of the main line altogether, because for a moment a wave like a little mirror has been just so placed as to cause the light striking it to reach our eyes.

WHAT MAKES A DIMPLE?

In order to understand a dimple, we should know the structure of the skin and what lies underneath it. In most parts of the body the skin, with its outer horny layer, and the inner living layer, which carries nerves and blood-vessels and makes the horny layer afresh from day to day, lies very loosely upon the layer of tissue beneath it. This is a loose layer, containing a certain number of fibres running in all directions, with fat-cells lying between them in healthy people—except under the skin of the eyelids, where fat is never found even in the fattest people. A few of these fibres are attached to the under surface of the skin, so that, though we can move the skin about very freely over what lies beneath it, there is, nevertheless, a limit to this movement.

But where there are dimples, as on the face, and often round such joints as the knee and the elbow, the number of fibres attached to the under surface of the skin is much increased, and they are rather short, so that the skin is depressed, or dimpled, at these points. We see what is really the same thing produced accidentally in the case of many scars, which are often a little depressed below the general level of the skin because they are tacked down in the same way. But a scar differs from a dimple, as the skin over a scar has been lost, and is replaced by a new thing called scar-tissue, whilst the skin over a dimple is true and healthy skin

IF MEN ARE GROWING TALLER, WILL THEY EVER BE TWICE AS BIG AS THEY ARE NOW?

The answer is certainly "No." Our increase in stature as compared with our ancestors is due to better conditions of life. We are far cleaner than they were, and eat more regularly. We have better and more nourishing food, and we protect ourselves better from great cold and heat. It is said that people have increased in height about an inch in 1,000 years, and this change in height is due to circumstances, and not to any change in the nature of the body. It is only that our ancestors were not as tall as they should have been, and we, on the whole, are nearer the height that we should be, though thousands of poor children are shorter than they would be if they had plenty of food and sleep.

When we go back to the earliest remains of human beings, we find that the average stature of mankind, though it varied in different races in the past as it does now, has been very constant. The ancient Egyptians of 5,000 or 10,000 years ago were rather short, just as modern Egyptians are. Men of a far more remote age, perhaps 25,000 years ago, who made the caves near Mentone, in France, were quite as tall as the modern Scot or Swede, and so on. Indeed, we learn no more important lesson from the past than that the physical type of man is very nearly fixed. It is his mind, and not his body, that grows; his skull gets bigger, but his legs remain about the same length.

WHY HAVE WE THE FEELING OF FEAR WHEN WE DO NOT WANT TO BE AFRAID?

Our feelings are not under the control of our will. There is no more important fact of human nature. Therefore, it does not matter whether or not we want to feel happy or angry or afraid, we cannot help feeling as we do.

But it is one thing to have a feeling, and another thing to show it, and it is yet another thing to act upon it. We should be quite clear in our minds as to what our wills can do, and what they cannot. As the question suggests, they cannot prevent us from having certain feelings; and they cannot give us feelings just because we wish them. But our wills can completely suppress the signs of feeling, so that a man may look calm, and speak with a steady voice, though he feels very much afraid; and, what is still better, our wills can prevent us from acting in accord with our feelings, so that, though we cannot help feeling afraid, we *can* help running away. We see, therefore, that there are two kinds of bravery. There is the bravery of the man who feels no fear, and so does not run; and there is the bravery of the

man who is terrified, *and yet* does not run. And perhaps it is finer to be afraid and yet stand, than to stand because you "do not know what fear is."

WHY ARE WE AFRAID IN THE DARK?

Children are often scolded for being afraid when they are left alone in the dark, but I am certainly inclined to sympathise with them, said the Wise Man. Fear is an instinct, and, like other instincts, it requires certain things to arouse it. The dark is one of these things. The strength of all our instincts varies in different people, and so does the degree to which they are aroused by different things; but to be afraid in the dark is undoubtedly a thing natural, or normal, to young children, and need by no means be a sign of real cowardice, or have anything to do with it.

Many students of instinct have tried to trace this fear of the dark to its origin; and though it is practically useless nowadays, we can understand that it must have been very useful indeed long ages ago, like all our instincts. It would, for instance, prevent children from straying in the dark, and would cause them to cry out so that they could be found if they were lost in the dark. Long ago, when all sorts of enemies, such as wild beasts, were lying in wait for their prey, it must have been a very good thing indeed that children should be afraid of the dark. Many grown-up people who are not cowards sometimes get the same fear, though perhaps they say nothing about it to anybody. We cannot be too sure, however, of this: that there is nothing whatever in darkness *itself* to make anybody afraid for a single moment.

WHY ARE WE AFRAID OF LOUD NOISES?

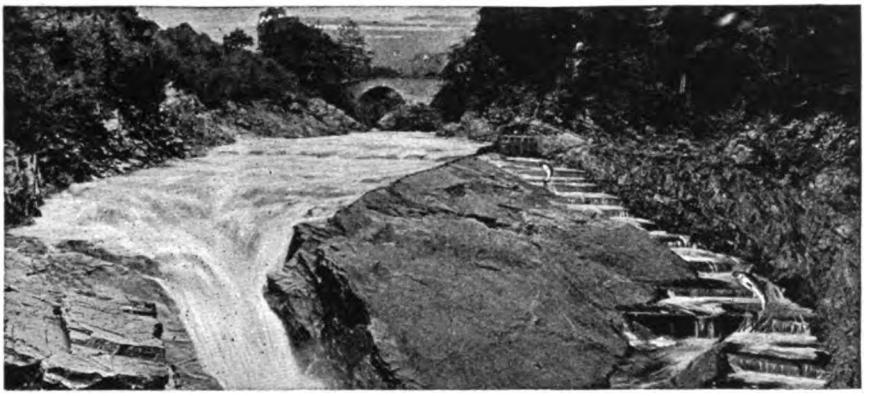
The fear of loud noises is a fear often noticed in children; and the interesting thing about it is that it is low-pitched noises, and not high ones, that a child fears. Often a child is made miserable by such a noise, even though it is perhaps safe in its father's arms in the daytime, and the father is making such a noise for fun. The child knows that there is no danger *really*, but this kind of noise makes it frightened, and it will beseech its father to stop. If, instead of merely laughing at such a child, we try to think what its fear means, and if we reflect that the kind of noise that it fears most is one which is like a growl, or like the deep roar of a wild beast, then we shall understand. The instincts of human beings are very deeply planted, and ages and ages do not suffice to root them out. If we study ourselves closely, and especially if we study children, we find traces of all the instincts that animals have—instincts still surviving from the time when man lived a wild life as animals do, and when these instincts were of the greatest value for his life.

WHY CAN WE NOT FLY LIKE BIRDS?

The more we study living creatures the more must we marvel at the way in which they are adapted to their particular mode of life. If, for instance, a creature is meant to fly, every part of it is adapted to that purpose. The bird's body is as light as it can be; it has large lungs to fill with air, and great air-spaces in its body besides. Then, too, its bones are very strong for their weight. The shape of its body, sharp in front and gently curved, is suited for flight. Its feathers are perfect for their purpose, and are beautifully oiled so that water cannot stick to them, for if it did it would weigh the bird down. The muscles made for flying are enormous in proportion to the size and weight of the whole bird, and they are so arranged in relation to the wings as to give the greatest possible power. The legs are of no use in flight, and are therefore made as small and as light as possible.

The pictures on the following pages show us how men are trying to learn to fly. But *we* are not meant to fly, but to walk and run. We have neither feathers like the bird, nor long fingers with a membrane stretched between them like the bat. As we are meant to walk, we have strong, heavy lower limbs, or legs; the muscles of our arms are very weak compared with the corresponding muscles of the bird's wings; the shape of our bodies is not at all suited for flight, and so on. Our intelligence may make us machines for flying with, but it cannot alter the fact that our bodies are not adapted for flight, and that they can never fly.

THE NEXT QUESTIONS BEGIN ON PAGE 2797



FISH OF THE RIVERS AND LAKES

CONTINUED FROM 2590

WE have all noted, in reading these stories of Nature, how fortunate we in North America are not to have sharks and other dangerous fish in the waters off our coasts. While feeling thankful that this is the case, the thoughtful student must wonder how it is that we lack the fishes that are dangerous to life, yet have those about us which are good for food. Here an interesting law of Nature comes to help the imagination.

As a general rule, the fishes which belong purely to the ocean cannot live in the fresh water of rivers and lakes. We can all understand this in regard to the deep-sea fishes. They *must* have a heavy pressure of water upon their bodies, or, as we have seen, they will die. Naturally, then, they cannot come into the shallows near the coast, to say nothing of the still more shallow waters of the rivers.

There is a further barrier against other sea fishes; they must have the intense saltness of the seas to which they are accustomed; and so they cannot safely stray beyond the limits of their home. Then there is the question of the warmness of the water. Ocean fish, accustomed to the upper levels of warm seas, would die if they had suddenly to move to cold seas. In this respect, the deep-sea fishes have a big advantage, for, although they cannot rise to the surface, they can travel very far, so long as the water is deep enough. Below a certain level the sea never varies in temperature; hence the deep-sea fishes could travel in deep water from the Equator to the Poles without feeling any ill effect.

But there are exceptions to every rule, and there is an exception to the rule that fishes of the ocean cannot travel far. Sharks go with the tide up certain rivers. They are to be found in the Lake of Nicaragua, and in the Viti Levu Lake, in Fiji, living always in fresh water. Again, we find a species of saw-fish, an ocean animal, living in a fresh-water lake in the Philippines. We have still more interesting exceptions to the rule in the case of fishes which, born in the rivers, like the salmon, go out to sea to grow; or, like the eels, born in the sea, come up the rivers to get fat and big. Some fishes, on the other hand, are so delicate that if we take them, with ever such care, from the rivers in which they were born, and place them in other rivers of the same sort of water, they die.

And yet others, like the fifteen-spined stickleback, we can bring in from the sea, turn loose in the river, and they will be all right at once. Then we have the lung-fish brought from South America, curled up in his mud-clod, to revive in a tank in a hothouse; while carp can be frozen solid in ice, and taken from one side of the world to the other, to melt out and be as lively as possible.

The king of fresh-water fish is the salmon. Some people call it the king of *all* fish. Certainly it is one of the handsomest and, at the same time, one of the pleasantest as food. Its life is a romance, which many great men have delighted to study, although they were for long puzzled by it. They used to see great salmon swimming up the rivers from the sea, and they used to see them swimming down again, but as there were no tiny salmon with them they could not think that salmon were born in the rivers.

WHERE DO THE LITTLE SALMON COME FROM, SWIMMING OUT TO SEA?

At other times they would see small silvery salmon going down the rivers by themselves, and they would wonder whence these had come. They sought them, but all they could find, when they made their search, were lots and lots of little fish, rather salmon-like in shape, but without silvery scales, and all barred across with black. These certainly were not salmon, they declared, or they would be like their parents.

But one year a keeper, a thoughtful Scotsman, employed by the Duke of Buccleuch, took some of these little black-barred fish and put them in a pond, and kept them there. He watched them carefully until the spring of the following year, and saw the black bars grow less and less distinct, and a growth of silvery scales appear. At last all the bars disappeared, and there, triumphant in their splendour of silver, were the little salmon, all impatient in their desire to go down the river to the sea. Let us now try to follow the life of the salmon, large and small.

SALMON AT SEA LONG FOR THE RIVERS IN WHICH THEY WERE BORN

We will begin in the sea with the big fish, which, we learn, came down the river some months ago. They feed with enormous appetites, eating shrimps, sand-eels, young herrings, and whatever else comes in the way of their splendid sharp teeth. They get very, very fat—so fat, indeed, that when they are caught we can see the flakes of fat, called curd, between their flesh. Well, after all this feeding, they begin to long more and more for the river. They swim into the mouth of the river. Instinct tells them whether it is fit for them to begin their journey or not. If the water in the river is very low, they know that they will not be able to get up, so they wait until rain comes to fill the river; then, out from the sea, into the fresh water they go.

They do not travel in great shoals as the herrings do, but in small parties, one group after another. All goes well at the mouth of the river—the course is wide, the water is deep, and swimming is quite easy. They do not bother about food; they have eaten enough to last them for a long time.

This is really a marvellous provision of Nature. The food which big salmon require is not to be found in the rivers. Now, if the salmon were hungry they would have to turn and swim back to the sea; they could never get up the rivers. But they leave their appetites in the sea, and as they go up the rivers their throats and stomachs contract, so that they do not want to eat.

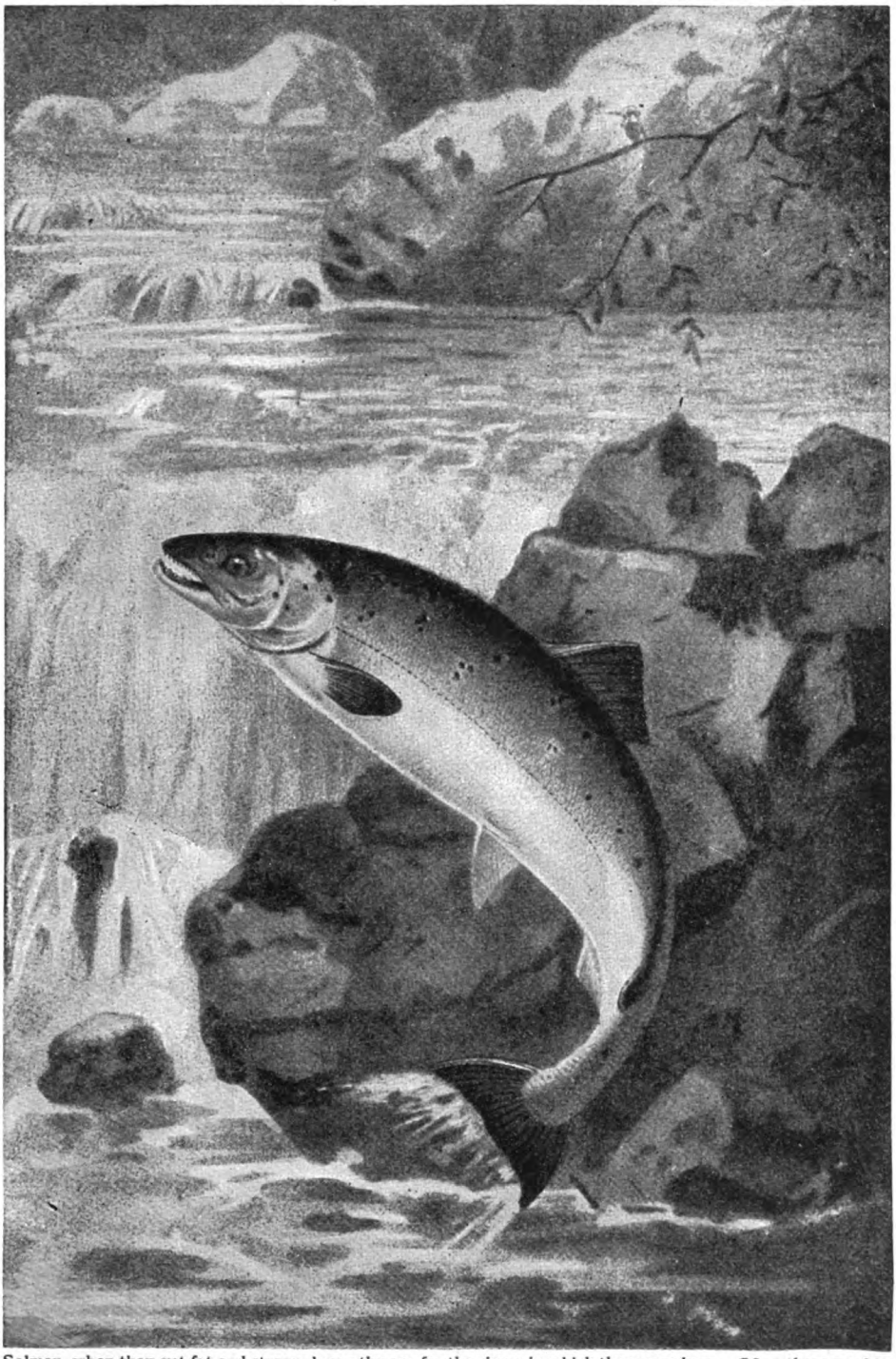
As they get higher up the river they are met by obstructions. There may be a natural barrier—a waterfall, perhaps. Well, salmon cannot be stopped by that.

HOW SALMON LEAP UP WATERFALLS AND CLIMB LADDERS IN THE RIVERS

Not even a fish can *swim* up rocks, but the dashing salmon makes his way up by a series of leaps and bounds. If the rise in the river be not more than six or eight feet, he will jump clean out of the water and make the ascent in a single bound. That seems to be about the limit of his powers. He does not believe it, however, and where there is a much higher obstacle he will gallantly go at it, though he may tumble down again and again in the attempt, and finally lie bruised and breathless on the rocks.

In many rivers where there are weirs, men make ladders up the rock for the salmon to climb. The ladder need not be broad, so that the rest of the river arrangements is not upset. It consists of a series of steps made of stone or wood, the steps placed, not right across, but about three-parts across the ladder, and arranged alternately. First we have a step branching out from the right; then we have a step branching out from the left. The salmon, after swimming from side to side of the river, and finding no natural way up over the rocks, soon learn that the path lies over this ladder, and up it they go, springing from side to side, just as the steps are placed. Of course, if there is anything

THE SALMON'S WONDERFUL LEAP



Salmon, when they get fat and strong, leave the sea for the rivers in which they were born. Often there are big rocks and waterfalls in the river, but the salmon, which is very powerful, leaps up the rocks. Sometimes, as we see here, a fish leaps over the rocks at a single bound. At other times it has to make many jumps, and to struggle up from rock to rock. When the falls are too steep, men make ladders to help the salmon.

like a gradual rise of rocks, or anything in the nature of what might be called jumping-steps, they will climb the highest waterfalls, just as we might. They are so strong, and spring so well, that, if it is possible for them to make a landing here and there only for a moment, they will master the ascent.

THE SAVAGE-LOOKING SALMON THAT FINALLY REACH THE HEAD OF THE RIVER

Well, in time they do get higher and higher up the river. They do not keep up this dreadful struggle day and night. After stiff climbing and swimming they come to nice sheltered pools in the river, and here they rest during the daytime, travelling for the most part at night. Still, they feel that they are called farther up the river, away to the source of it, even though it rise among the mountains. By this time a change has come over the appearance of the fish. The female has become darker in colour; the male has lost his gaudy beauty. He has become a gloomy red in colour, blotched with orange and dark spots. His shoulders have become thinner, and his head seems bigger and fiercer. The lower jaw, since he left the sea, has developed a fierce and huge beak, and the male salmon is savage and ugly to look at, and ready to quarrel with his own shadow. The reason is that he expects to have to fight for his mate.

Terrible battles now take place among the male salmon. Many of them are killed outright in the strife, and many more badly injured. In one year 300 salmon were killed in the Tay during these fights. When all the battles have been fought, or even while they are going on, the female makes her nest and lays her eggs.

THE NEST MADE BY THE MOTHER SALMON TO RECEIVE HER EGGS

Yes, she makes a nest, rough though it is. The spot that she chooses is always the gravelly bed of a swiftly flowing stream. The nest is made by the salmon lying on her side and ploughing up a trench by the vigorous wriggling movements of her body. In this trench she lays the eggs, then heaps the gravel over them. She may deposit eggs day after day for about ten days. A salmon lays about 900 or 1,000 eggs for every pound of her own weight. Thus, a salmon weighing 20 lb. will lay close upon 20,000 eggs. We reckon about 25,000 salmon eggs to the gallon, and a salmon weighing 25 lb. is expected to deposit a gallon of eggs in the nest which she makes. When the eggs have all been laid, the salmon, helped by the male, covers them all carefully over with gravel to a depth of some feet.

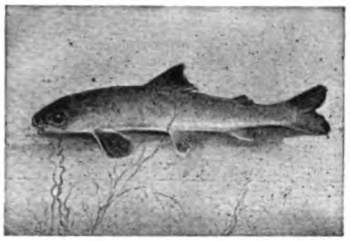
The purpose of the rough and tiring journey has been attained. The salmon have come up to lay their eggs. They could not lay them in the sea, for the eggs, of our salmon at any rate, must be laid in fresh water. There they will lie in the gravel for the next ten weeks at least, or it may be even twenty weeks. It all depends upon the weather. The eggs are laid in the autumn, and the little salmon hatch in the depth of winter. Meanwhile, the old ones return to the sea. Men do all in their power to catch them as they ascend the river, but the fish are not molested on their way down to the sea.

THE SALMON'S BABY DAYS AND HIS COAT OF SILVER FOR THE SEA

Now we must follow the little salmon. When born they are ugly little things, with part of the egg attached to them. This part contains the food upon which they will live for the next month or six weeks. The baby fish has a mouth, but it takes no food during this time, relying upon the substance contained in its little pouch. When it begins to feed it is only a modest little creature of 1¼ inches in length. Four months afterwards it is double this length.

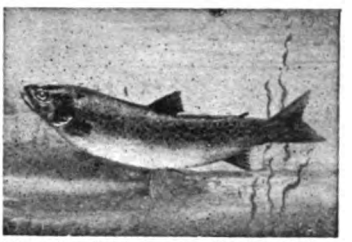
Now, for perhaps a couple of years, the young salmon has nothing to do but to eat the food which the fresh water furnishes, to grow fat and strong, and develop the armour of silvery scales which it is the ambition of every juvenile salmon to possess. When these have at last come, the young salmon become very restive and desire to see the world. So, between March and June, they set out in shoals for the sea. They pass easily over the waterfalls and weirs and other obstacles in their way, but, no matter how fast they go, they seem to note the route so as to be able to find their way back. Not all the youngsters go down together. Some may go down after a year, others may remain at home for three years before setting out. And not *all* that go out return to the river in which they were

SOME COMMON FISHES OF OUR RIVERS

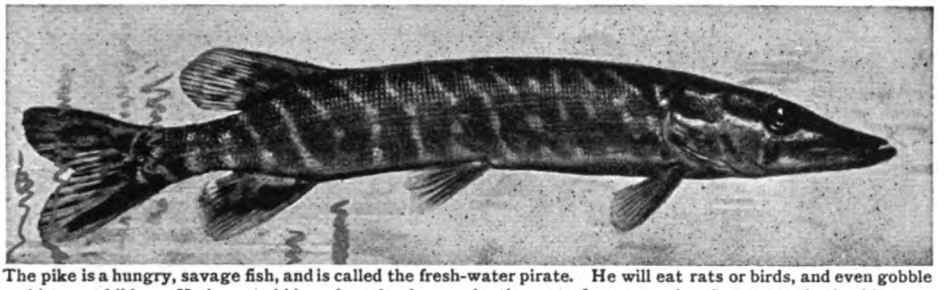


A young salmon like this undergoes many changes before it becomes the handsome fish that goes down to the sea to grow big.

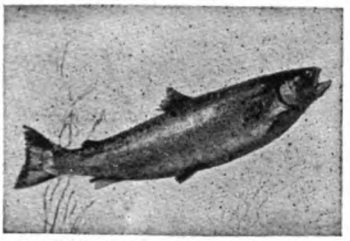
Gudgeon are common English fish. They are often used as bait to catch other fish.



Trout flourish in nearly all of our lakes and streams which have pure water. One was caught in Scotland weighing 29 lb.

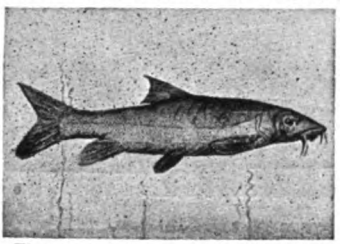


The pike is a hungry, savage fish, and is called the fresh-water pirate. He will eat rats or birds, and even gobble up his own children. He loves to hide under a bank or under the root of a tree, and to dart out and seize his prey.

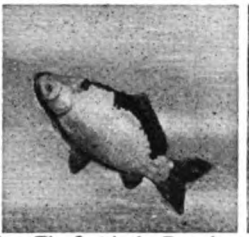


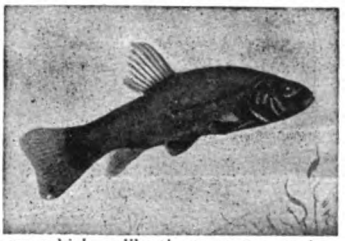
The salmon trout are also called sea-trout. Born in the rivers, they swim out to sea, but return to the rivers to lay their eggs.

The minnow is a tiny carp, common in all our waters, even in the smallest ponds.

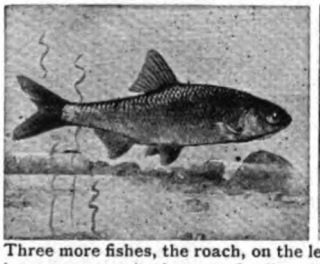


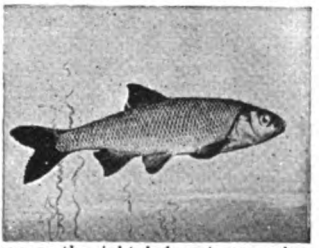
The barbel is a comfortable fellow, who sleeps when frozen solid in ice, and wakes up none the worse when thawed.





These are three members of the carp family. The first is the Prussian carp, which, unlike the common carp, has no pendants from the lower jaw. The third is the tench, which passes the winter asleep in the mud. The second is the golden carp, or gold-fish, which we keep in small bowls. It prefers to live in large tanks of warm water.





Three more fishes, the roach, on the left, the c ub, in the centre, and the dace, on the right, help us to remember how numerous is the carp family. These differ much in size and form from minnows and gold-fish, but are all members of the same carp family.

born. Some wander into other rivers, but the majority go back to their own.

Those that are to return in the first year have not long to stay in the sea. They eat, and eat, and eat as much as they can, and grow at a marvellous rate. They go out as smolts—that is their name in the first seaward-going stage of the youngsters—and then they weigh only a few ounces. They stay three or four months, and return as grilse—that is, young salmon, different from the big salmon only in point of size. But when they come back the fish of a few ounces have grown in three or four months to from 3 lb. to 6 lb.

THE SALMON'S MANY ENEMIES AND HOW NATURE PRESERVES THE FAMILY

They have had their fill of rich sea fare; they long now for the home in which they were born. Little salmon and big salmon set out for the river-head again, and little ones and big ones go for the same purpose, to lay their eggs, so that the stock of salmon in the world shall not fail. It is well that they lose no time, for, though the eggs of salmon are so numerous, their enemies are countless. Big trout eat the eggs which escape from the nests. Birds and fishes eat the young ones in the streams. Big salmon eat the little ones as they go down the stream; sea-gulls and other fish-loving birds plunge into the water after them; and sea-fishes, and, in some countries, seals and sea-lions, lie waiting at the mouths of rivers to eat salmon till they can eat no more.

Still, where the water is pure and the way at all open, the supply of salmon is wonderful. In rivers in British Columbia and Alaska, when the salmon go up from sea they make their way in such vast hordes that, pressing on to the top of the rivers, they actually fill the channels.

HOW MEN REAR SALMON AND SET THEM FREE IN OUR RIVERS

Some of the finest salmon in the world are caught here. Some weigh 60 lb. or more. European salmon cannot equal with the 100-lb. salmon which are caught in American rivers, but there is no salmon better in quality than a British salmon. The Irish and Scottish salmon fisheries are important, but not nearly so important as the American, where, in Alaska and the Pacific States, men catch about 100,000,000 lb. weight of salmon a year. In 1899 the total weight of the salmon that were caught in America was 175,000,000 lb.

In spite of the enormous numbers of salmon which are hatched naturally, men have now learnt to hatch salmon eggs artificially. The eggs are taken after the fish have laid them, and carefully preserved in hatching-ponds. When the young ones appear, they are kept in great ponds, safe from enemies and well fed, until they have reached a size at which they are able to take care of themselves. Then they are turned loose. In this way we are able to stock rivers which have no salmon.

Included in the famous salmon family we have the salmon trout. These are also called sea-trout. They are not so large as the salmon, though some weighing between 20 lb. and 30 lb. have been caught. Their flesh is pink, like that of the salmon, but not so rich. Their habits are like those of the salmon, for they ascend rivers to lay their eggs; and, as they are smaller than the salmon, and therefore not so strong, we may imagine how great is the courage they show in overcoming the difficulties in the way of barriers which tax even the strength of the great and lusty salmon.

THE TRAVELS OF THE TROUT IN RIVERS AND ITS JOURNEYS OUT TO SEA

The sea-trout and the bull-trout are the only members of this family which go out to sea. The others remain all their lives in fresh water. These are among fish which very often we see leaping out of the water after flies. They are hungry creatures, and eat any number of other fishes' eggs, and even young fish. But the food of which they are fondest consists of fresh-water shrimps and worms and slugs, which heavy rains wash into the rivers and lakes. But they are not particular; one was caught which had a young viper in its mouth. They have the wonderful power of making their colour fit their surroundings.

The trout show the same instinct for the preservation of their species as the salmon. Between the beginning of October and the end of November they make their way to the gravelly head of streams, and there they lay their eggs as the salmon lay theirs, and carefully make a nest.

We pass now to a very stay-at-home fish—the pike. This is the fiercest fish

in our waters. He will eat anything—rats, ducks, water-hens, young geese, fish, frogs, snakes, and even his own family. The only thing to which he says "No" is a big, healthy perch, whose sharp spines are too much even for the mouth of the river-pirate, as fishermen call the pike. If the young pike, or jack, as it is commonly called, can escape the jaws of its relations, it soon grows into a nice-sized fish, and shows itself as hungry as its parents.

HOW THE CARP CAN GO ROUND THE WORLD IN ICE AND WAKE UP AGAIN

One youngster, only five inches long, was found to have swallowed a gudgeon as big as itself, and was cheerfully swimming about with the gudgeon's tail sticking out of its mouth. The pike makes its home in a hole under a bank in weedy water, there to lie in wait for anything eatable that may come along. If nothing happens to affect it, the pike will go on growing for years and years. The average weight of a good pike is from 12 lb. to 20 lb., but they have been caught weighing 60 lb.!

A fish of the river and lake about whose age we know more is the carp, which was introduced into America from abroad more than forty years ago. Nothing seems to come amiss to it. Its first home was in China, but it flourishes equally well in Germany and Sweden and England. We can freeze the carp into a solid mass of ice, send it on a journey round the world, then revive it by melting the ice, and the carp will wake up and go about its feeding as if nothing had happened. But it does that sort of thing naturally.

FISHES STILL LIVING IN A STREAM WHERE MARIE ANTOINETTE MAY HAVE FED THEM

When the weather turns cold, and its pond freezes, the carp go to sleep in the mud under the ice, and bother no more about the world and its troubles until spring's warm hand melts the ice and summons all living things to renewed activity. Taking life so easily, the carp naturally lives to a great age. In the stream running through the park in which poor Queen Marie Antoinette spent her happy days are great fat carp, crowding the water as they did in her day. It is said that in that stream there are to-day the very fishes which the poor queen fed 120 years ago.

The gold-fish which we keep in bowls and ponds are carp. They are wonderfully hardy creatures. They like hot water—that is, if they have plenty of it, not in tiny bowls. Very often they are kept in ponds into which the hot water from steam-engines flows. We always find them at the top, where the water is hottest. They get as fat as butter in water which is 90 degrees—nearly as hot as our blood. But if the pond freezes, all that is done is to crack the ice at the top to let them get air. Perhaps even that may not be necessary. Theirs is a very different constitution from that of great things like conger-eels, which, though accustomed to cold water, cannot sink if they come to the surface when there is a keen frost.

The carp tribe is quite a big one. Barbel, for which those men angle who cannot afford the luxury of salmon and trout fishing, form one branch of the family. Another branch includes the gudgeons, humble little fish which men catch mainly to use as bait for bigger fish, though the larger ones form excellent food for the table. We must not stay to examine the roach, chub, and dace, as they are so well known.

A FISH THAT LAYS ITS EGGS IN THE SHELL OF A MUSSEL

But we must not neglect the minnows, their small relations. Every boy or girl who has ever put a fishing-net into a pond may have been puzzled to know why these little fish are so differently coloured at different times. The fact is that the minnows, when excited by food, become much brighter in hue than when quiet; and at night they are the soberest-looking little fish alive. They multiply rapidly, and are a never-failing source of food for larger fresh-water fish.

The tench is another form of carp, and, like its big cousin, loves to grovel in the mud and to sleep there, buried, during the cold weather. The tench lays many eggs, but not so many as a big carp proper, which lays about 700,000.

We all think of the minnow as the smallest of our fish, but there is a smaller one—the bitterling. Of this, the female is only about 1½ inches long, while the male is about twice as long. The minnows serve us for food when they are dressed up as "whitebait"; but the bitterling is as bitter to the taste as its name implies, and we can use it only as bait

for eels and perch. But it is an interesting little fish, for it has the cuckoo's habit of causing other creatures to hatch its eggs. The bitterling, when she wishes to lay her eggs, seeks the fresh-water mussel, and places the eggs within its shell. There they develop and are hatched, and the little bitterlings go off from their strange nursery not exactly knowing whether they are going to grow shells or fins.

Another of our common fish is the bream. Anglers are quite happy if they catch one weighing a pound or two; but the giants of the family, living in Irish lakes, attain a weight of 12 lb. or 14 lb.

Keeping still to the carp family, we come next to the bleak, a handsome little fish which pike and trout and similar fishes, as well as sea-gulls and terns, much relish as food. Bleak are interesting chiefly because of their beautiful pearly scales. These are so handsome that for ages they have been used in the making of artificial pearls.

FISHES WITH DOUBLE EYES AND FISHES IN CAVES WITH NO EYES AT ALL

There remain now some of the fish remarkable in regard to their structure or their habits. One is the famous double-eye of tropical America. Its eyes are among the strangest in the world. Each eye is really two eyes. The upper portion is shaped like a lentil, so is called lenticular; the lower eye is oval. The reason for this extraordinary formation is that the fish, when swimming, carries itself near the surface of the water, with the upper part of the eye just out of the water, and the lower half beneath the surface. Thus it can see what is happening in the air above it, and at the same time mark the progress of events in the water.

While these fishes have two pairs of eyes, there is one fish with no eyes at all. We know that there are blind fish at the bottom of the deep seas. No light can reach them, so some of them have no eyes, while others have to depend upon their own phosphorescence or that of other creatures, and have enormous eyes to catch any ray of light from such sources. But in the fresh-water fishes we do expect to find eyes. However, in the famous fishes of the great caves of America we find the eyes completely missing. In those still, deep waters there is no light. It is a dark subterranean fresh-water sea in which these fish live, and they are as blind as the rocks amid which they swim.

To make up for this they have remarkably acute hearing and sense of touch. They can detect the presence of a human being if he makes but the slightest sound near them, but if he keeps perfectly quiet he can catch them in his hand or net as they swim, pale and blind, to the top of the water. They find their food by their delicate sense of touch, which resides in a series of nerves upon the two top sides of the head.

FISHES THAT LEAVE THE WATER AND CRAWL MANY MILES ON DRY LAND

The perch, which is common in our rivers, is remarkable to us for two features—the enormously strong spines with which its back is armed, and the number of eggs it lays. A little perch, weighing only half a pound, has been known to lay more than a quarter of a million eggs. But the strangest perch of all the family is the climbing perch. This wonderful creature lives in India and Ceylon, where streams and ponds are apt to run dry. It waits as long as it can before moving to fresh quarters. The water gets lower and lower, and the fish may be seen melancholy in the mud.

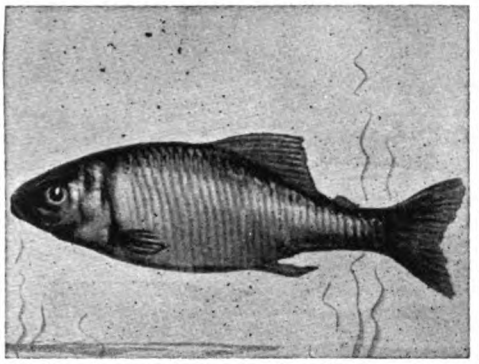
At last the fishes can delay no longer. They climb the banks and set out for some place where, by a mysterious instinct, they know water is to be found. Their lower fins and strong backbone enable them to crawl along the dry land, and, of course, they breathe the air. In order that they may not die, as most fish would, they have a special arrangement inside the mouth which enables them to retain a large amount of water with which to keep their gills moist.

THE TRAVELS OF THE CLIMBING PERCH IN THE BLAZING NOONDAY SUN

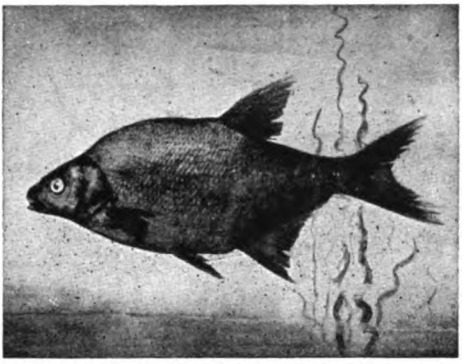
So long as they can keep their gills damp they can live, and they scurry along to some other stream or pond, and topple in, thankful to get back to their native element. It is said that they climb trees, either to drink the water collected in big hollow leaves, or to catch insects reposing there.

Naturally, if they can, they make their way at night, when the dew is on the ground, but sometimes their journey takes them longer than they expect,

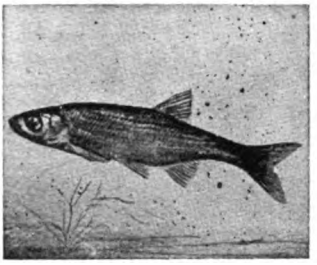
NESTING FISH AND A FISH THAT WALKS



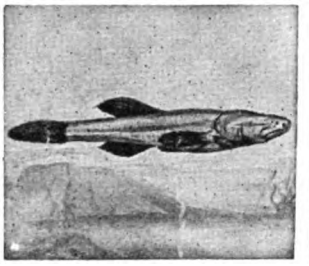
The bitterling lays its eggs in the shells of mussels, so that they may remain unnoticed and be safe from danger.



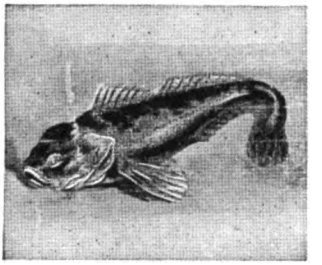
The bream, like the bitterling, is a carp. There are fifteen species of bream, of which two live in British rivers.



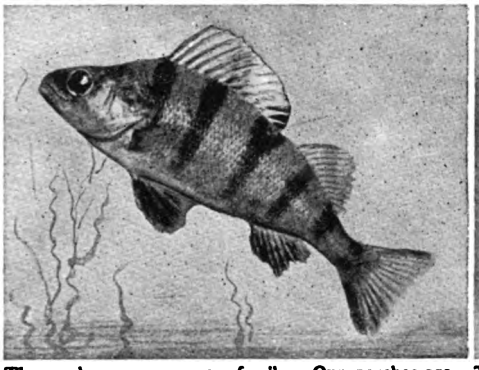
The bleak, another small carp, has such beautiful scales that they are used for making artificial pearls.



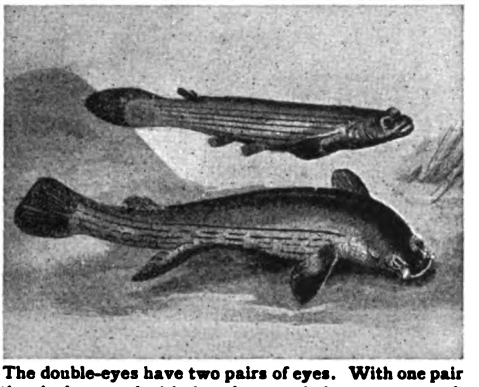
The Kentucky blind fish has no eyes, and lives in waters enclosed by great caves where no light enters.



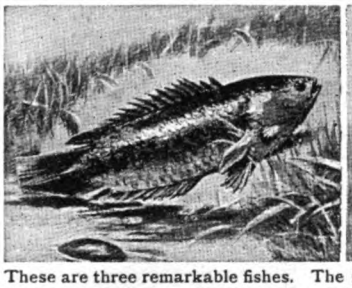
The bull-head eats other fishes' eggs, but defends his own with skill and courage against all enemies.



The perches are a numerous family. Our perches are small, but some in India, used as food, are 5 feet long.



The double-eyes have two pairs of eyes. With one pair they look up, and with the other watch the water around.



These are three remarkable fishes. The first is the climbing perch, which, when his stream dries up, walks on dry land to find other water. The second is the little stickleback, which makes a nest and fights like a hero for his children. The third is the paradise-fish, which forms a nest of jelly-like bubbles blown from its own mouth.

The photographs on these pages are by S. and W. Johnson, W. S. Berridge, Lewis Medland, R. Thiele & Co., H. J. Shepstone, and others.

and they have been found in the glare of the noonday sun, labouring along the dusty road, still hoping to reach the water which they set out to find.

Six of these fishes were taken to the Zoo in London, in November, 1908. On the way over from Ceylon to London it was no uncommon thing for them to climb out of their tank in the night, and to be found sporting about on deck in the morning. Some which are kept in a Zoo on the Continent have been seen to leap a height of 16 inches and to make their way 20 feet across a sandy floor. This is a good performance for a fish only six inches long.

The spines of the perch are formidable, as the pike well knows, but they are less terrible than those with which the little stickleback is armed. The stickleback is one of the commonest fish we have in our waters, but his life is as interesting as any. The little male stickleback is one of the best of fathers.

THE WONDERFUL NEST THAT THE CLEVER LITTLE STICKLEBACK BUILDS

He makes a wonderful nest for the reception of the eggs. He gathers pieces of delicate fibre and weaves them together with his mouth, then places them in a little trough or other recess which he finds or makes for himself. He tries each piece of material to see that it is heavy enough to sink and cannot float away. If it is not quite as he wants it, he brings a little sand and drops that upon the material to weight it down. When all is ready he coats the fabric of the nest with a sort of cement which he produces himself, and makes a hole through it to allow his mate to pass in at one side and out at the other.

Then the female stickleback appears and lays her eggs in the nest. For the next three weeks the male stickleback guards the nest day and night. Big fish come up and try to get the eggs, but the brave little sentinel rushes at them with such force that, if they do not retire, his terrible spines may rip them open. Fish twenty times his own size he will put to flight in this way. This does not complete his cares. The eggs must be frequently moved so that they may all benefit by a full supply of fresh water. The intelligent little creature fans the water with his fins so as to force a current right through the nest, and he will also seize the nest in his mouth and rearrange the eggs within it, so that there shall be no possible chance of the eggs not being all treated alike by the pure water.

A FISH-FATHER WHO FIGHTS FIERCELY TO PROTECT HIS FAMILY

In three weeks' time the little fish hatch, and then his troubles are increased. The tiny things have no sense of danger, but swim about where hungry fish can catch them. He knows all about their peril, and, rushing after them, beats off the fish which would attack them, then carries the truants back, one by one, in his mouth to their nest or to the bottom of the water, where he can keep them together and safely guard them. When the young ones grow up, the father relaxes his care and soon dies.

The paradise-fish of China is another famous nest-builder. But here the nest is made entirely from materials supplied by the male fish. He blows bubbles of mucus from his mouth, and forms a nest under the water like that which the little insect called cuckoo-spit forms on our flowers. In that he places the eggs which the female fish lays, and there are born the little fish which it becomes his business to guard.

The Chinese are very fond of keeping the paradise-fish as a pet, and it will live in almost any water, no matter how stale or how dirty it may be. In muddy water it is brown, but in clear water it becomes a golden red.

HANDSOME FISHES THAT "SIT" ON THEIR EGGS AND HATCH THEM

We have in the little bull-head of our clear northern streams a fish that eats other fishes' eggs. The eggs of the bull-head are placed in a hole which the male fish makes. He guards the eggs as carefully as the stickleback guards *his*. But there are fishes which actually sit upon eggs, even as birds do. These are members of the gay family of chromids, found in Africa and tropical America. The males make nests for the eggs, and rest in the nests upon the eggs until the latter are hatched. Among fishes there are many cannibals which eat their children, but there is some compensation for this in the examples of care, attention, and affection that we have been studying.

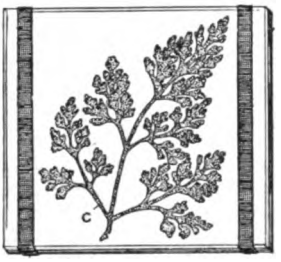
The next story of Nature is on 2815.

PHOTOGRAPHY WITHOUT A CAMERA

CONTINUED FROM 2573

MOST people think that nobody can take a proper photograph without a real photographic camera, but this idea is quite wrong. We shall see how any boy or girl can take a photograph without a camera.

In picture 2 there is a photograph of a lake scene, and on the next page is shown a picture of a little girl and a photograph of some leaves. Well, these photographs were taken without a camera of any sort. It took about half an hour to do them, and each one cost only a cent or two.



1. The photographing frame

If we would like to do some like them, we must first go to a shop where they sell things for photographers and ask for a packet of "self-toning" paper. All photographic shops keep it, and it is not at all expensive. One packet will last a long time, and we can take twelve big photographs, or forty-eight little ones, about the size of the one on this page, with it.

Then we must ask for one pound of "hypo." This is also very cheap. That is all we need to take our photographs: just one packet of self-toning paper and one pound of hypo.

We open the packet of paper, and find that it is shiny on one side. Now, if we cut a little piece off one sheet, and take it out of doors into the light, we shall find that in a few minutes the shiny side begins to turn dark. We can watch it getting darker and darker until it is quite black. If we hold it by one corner, we shall see that the little piece our finger has covered will remain as white as it was when we first took the paper out of the packet. This is because the light could not reach the place which was shaded by the finger.

2. Photograph of picture taken without a camera

When we have done this we shall understand what photography really is. We shall see that we have a wonderful kind of paper which turns black when it is taken into the daylight; and, if we shade some parts from the light, those parts will remain white while the rest of the paper becomes dark.

Now we can see that if we lay a leaf or a small flower on the paper, and leave it in the light for a little time, we shall get a perfect copy of that leaf. That is the way the photograph of leaves on the next page was taken.

Of course we shall find that the leaves, when we first pick them, are crinkly, and will not lie flat on the paper. We must press them closely to the paper by putting a piece of glass over them if we want our photograph to be clear.

The best way is to get a small piece of glass about five inches long and four inches wide. Probably we can find a piece in the house. A glass from an old picture or photograph frame will do quite well. Then we should cut a piece of thick cardboard the same size as the glass, and get two strong elastic bands to hold them all together.

Now, whenever we want to photograph the leaves we lay them first on the glass, then put a piece of the paper over the leaves, and the cardboard over the paper. The two elastic bands slipped over the glass and paper, in the way that is shown in picture 1, will make everything ready for taking the photograph.

We have now only to take it all out into the light, and leave it in the sun until the paper seen through the glass has turned quite black. Then we must take it indoors,

and when we slip off the elastic bands we shall find a wonderful picture of the leaves, with all the delicate veins showing clearly.

Now, we must understand that this picture has appeared in this wonderful way because the leaves have shaded some parts of the paper while the other parts have been getting quite dark. If we take our photograph out into the daylight again, it will become dark all over, and the leaves will not show any more. We do not wish this to happen, so we must do something else before the photograph is really finished.

3. A portrait taken without a camera

We must use some of our hypo. This stuff looks something like the soda we have seen in the kitchen. Well, we must take some of this hypo—about two teaspoonfuls will be enough—and put it into a soap-dish and pour some water on it. In a little time the hypo will dissolve in the water, and then we must put our photograph in it and leave it there for ten minutes. It will turn red at first, but will afterwards get dark again. When this is done, we take the photograph out and put it into a basin of water.

It is best to leave the basin under a tap in the sink, and let the water run into it for two hours; or, if we have a washhand-basin with a tap over it, we can put the photograph into that. It must be washed in clean water for at least two hours, or it will not last. We have now only to take the photograph out and let it dry, and it is finished.

When we have done one, we shall probably like it so much that we shall want to do a lot more, so we must look for new things to photograph.

Perhaps when we were at the seaside last summer we brought back some pieces of that pretty pink seaweed. If so, we shall find that this makes lovely photographs. Some kinds of feathery grass make very pretty pictures, too; and little pieces of fern look lovely if arranged nicely before the photograph is taken.

4. Photograph of leaves taken without a camera

We know one boy who is so fond of making these pictures that, whenever he goes out into the country, he brings home leaves from the different trees he sees. Then he photographs them, and puts the pictures into a little album, and underneath he writes the name of the tree each leaf came from.

Of course, there are lots of things that one can photograph besides leaves and flowers. We can copy pictures of people or outdoor scenes. Any picture from a book or a magazine can be photographed without a camera, if it has been printed on paper that is white at the back.

In THE CHILDREN'S ENCYCLOPÆDIA you will often find a coloured picture in the volume. We can make a photograph of one of these very easily. All we have to do is to take the coloured picture and put a piece of self-toning paper against it. Then we put them both between the glass and the cardboard, exactly as we did with the leaf or fern, and leave it all in the sunlight.

When we take the paper out, we shall find a copy on the self-toning paper. We shall, however, find that the black lines of the picture are white in the photograph; and if we do not like this we must take another photograph from our photograph, and then everything will be right. We shall have a real copy of the picture, with the dark parts dark and the light parts light, just as they should be.

When our friends see how well we can take these photographs, they will probably ask if we cannot copy some portraits for them. This is just as easy if the portraits have not been stuck upon cardboard. If they have been "mounted," as photographers say, we must first soak them in water for a few hours, and then peel them off the card. Then, when the portraits are dry, we can use them just as we used the pictures from THE CHILDREN'S ENCYCLOPÆDIA, and we shall be able to do just as many photographs of our friends as we want.

Remember, for copying other pictures we must take two photographs, because the first one shows the faces black. This first photograph is called a "negative"; but when once we have taken it we can make many photographs from it, and the second ones will be just like the real portraits which our friends lent us at first.

ANSWERS TO THE GAME OF "WHY IS IT?" ON PAGE 2570

1. The space allows for the rails to expand when heated by the summer sun.

2. The friend's image is reflected from the glass at the same angle as that of the little girl in the corner looking into the glass.

3. Rays of light from the steps and the shell did not reach our eyes in a straight line, but bent down towards our eyes on passing from the water into the air. So the shell and the sand appeared higher than they were.

4. A three-sided lustre in the glass chandelier acted as a prism and broke up the sunlight into the bars of colour.

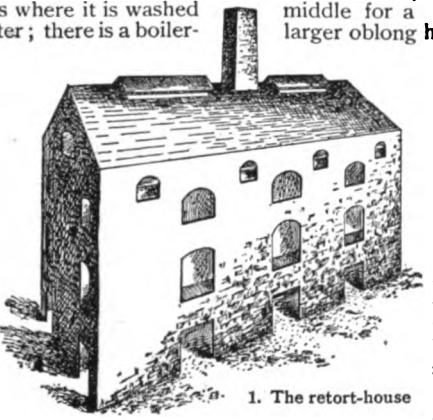
5. The call echoed from the rock on the opposite side of the valley, at an angle the mother knew would just reach her son.

6. The corner of the handkerchief acted as a syphon, and the scent passed up along the threads in the material and down into the rest of the handkerchief.

MAKING MODELTOWN GASWORKS

As towns grow in size the people usually get what are called public services, which include such things as gasworks and waterworks, and sometimes electric-light works, and a street car system. When the town was only a few houses, and was then not really a town, but only a village, it would not have been worth while to put up gasworks. There would have been so very few people to use the gas that its manufacture would not have paid. But now, when Modeltown has grown into an important town with many buildings, a large hotel, and many houses and shops, we can erect gasworks. We shall therefore do so now.

We have all seen the large gasholders that move up by the help of wheels as the gas flows into them after it is made, or that sink down into the ground as the gas is used up in the gas-lamps and stoves of the town or city. But a complete gasworks is much more extensive than merely the gasholders. There is first the building—called the retort-house—where the gas is made from the coal; then there are two high towers where it is washed free from tar by falling water; there is a boiler-house and an engine-house containing an engine and pumps to force the gas through the pipes to the large gasholders. All these buildings, although they are quite numerous, are very easy to make.



1. The retort-house

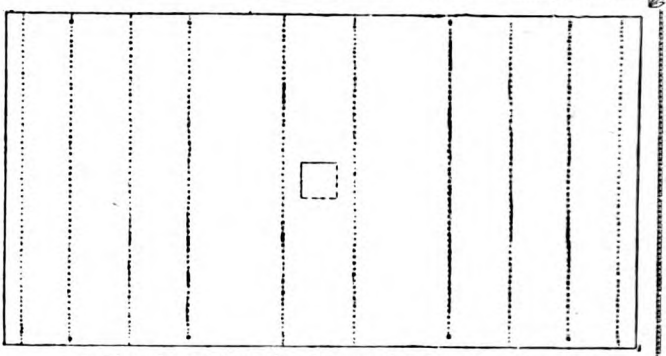
We shall begin with the retort-house, where furnaces are always burning and heating the *retorts*. A retort is just a sort of oven in which the coal is roasted in order to set free the gas which the coal contains. The retort-house, when completed, will be like picture 1. Remembering the instructions about making the drawings upon our building card, and cutting them out, and also the meaning of the three different kinds of lines as explained on page 446, we make drawings from pictures 2, 3, 4, 5, and 6. Picture 2 is quarter-scale, so that in making it we take our sizes from the picture by using scale-rule D, making our lines upon the card with our full-sized rule. Pictures 3 and 6 are one-third scale, so in drawing them we use rule C for taking our sizes. We make two pieces of each of these. Pictures 4 and 5 are half-scale, so for them we must use scale-rule B. As we fold up the drawing we make from picture 2, we must notice that some of the lines must be half-cut and bent on the opposite side of the card from the drawing, as already explained on page 446 and elsewhere.

As we bend up the card of the piece made from picture 2, it will take the shape shown in picture 7. At each side there will be a long ledge formed by two thicknesses of card. Put thin glue between the surfaces that touch, and this will make strong ledges or stages upon which the men would work if ours were a real gasworks. The retorts are above these stages and the furnaces are below them. When this has been done we glue into each open end, seen in picture 7, one of the pieces we have already made from picture 4. That will give us a building closed on every side and having a ledge or stage back and front. Glue this down to a sheet of cardboard or strawboard, which will form the ground for our gasworks.

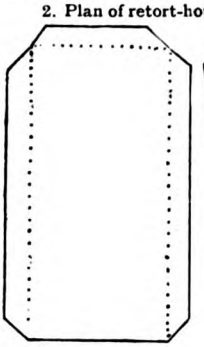
Now fold up the drawing we made from picture 5 into the shape of a square tapered funnel or chimney-stack, and glue it to the top of the building we have made, fitting it to the square shown upon the drawing in picture 2. The middle of the top of the building with the funnel fixed into position will be like picture 8. Now cut out the piece made from picture 3, and fold it up as shown in picture 9. We find that there are three holes in the roof, one square hole in the middle for a chimney-stack and two larger oblong holes for ventilation. We cut eight short pieces from wooden matches, and with their help glue above the oblong roof holes the two pieces of card we made from picture 6, so that they will look like picture 10. We now drop the whole building down over the tall chimney and over the interior we made from picture 2, and the whole retort-house will be complete, as already seen in picture 1.

The next part of our gasworks is our washing and scrubbing towers, which are shown complete in picture 11. To make the bodies and the tops we must use very thin cardboard, as they have to be bent to circular shape; perhaps good, thick notepaper will do as well. We make two pieces from picture 12, which is one-third scale, and therefore requires the use of scale-rule C, and two pieces from picture 13, which is half-scale, and for which we use scale-rule B. Now draw upon stouter cardboard, and cut out, two rings as shown in picture 14, and six circles or discs as shown in picture 15, both of which are half-scale, so that we use scale-rule B for both. We should use compasses in making the circles, and when we make circles from a half-scale drawing, the simple way is to take the diameter of the drawing with our compasses and use that distance for the radius of the circle on our card.

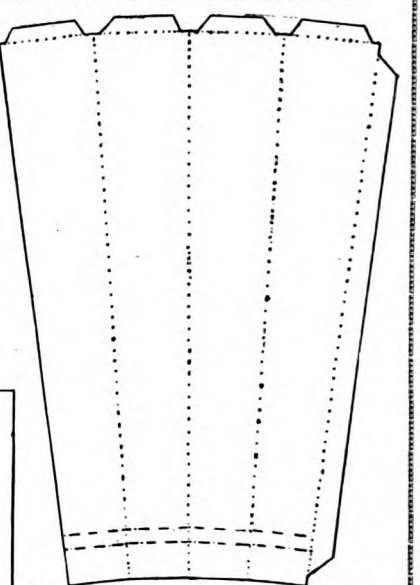
Make and cut out the drawings in pictures 16 and 17—one of each—which are half-scale, and therefore require scale-rule B in taking the measurements from the pictures. One line in picture 17 shows that the card must



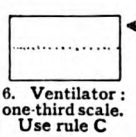
2. Plan of retort-house interior : one-fourth scale. Use rule B



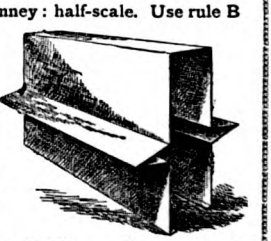
4. Plan of end piece : half-scale. Use rule B



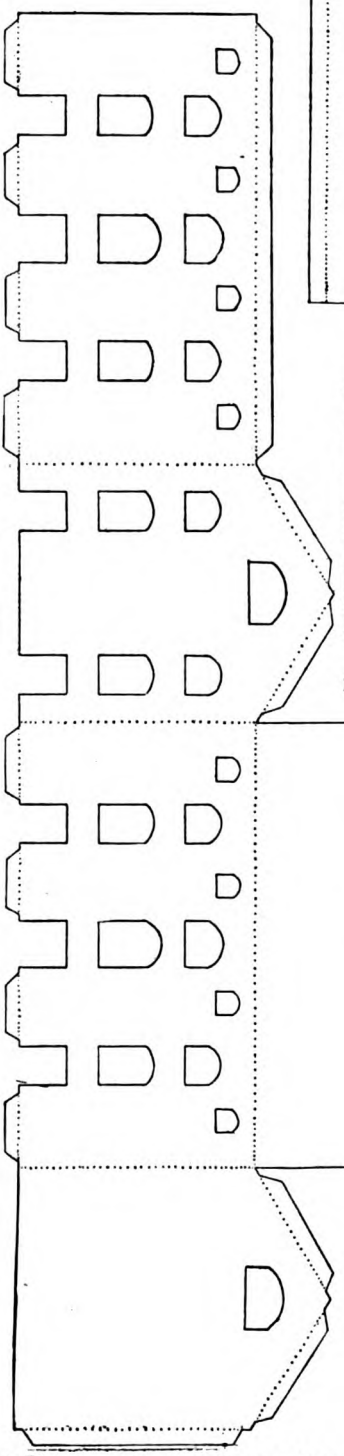
5. Plan of chimney : half-scale. Use rule B



6. Ventilator : one-third scale. Use rule C



7. Folding up the interior of the retort-house

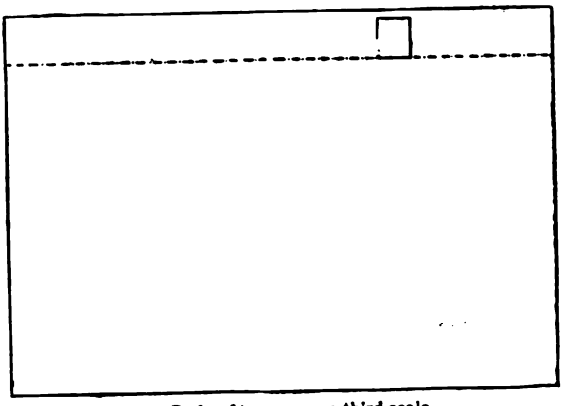


3. Plan of retort-house walls : one-third scale. Use rule C

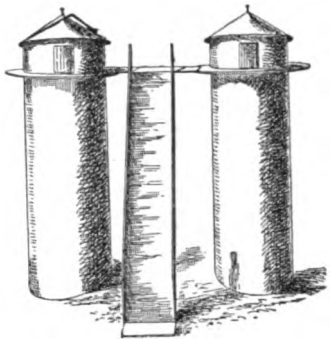
8. Retort-house chimney

9. Folding walls of retort-house

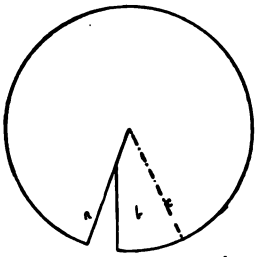
10. Retort-house ventilator



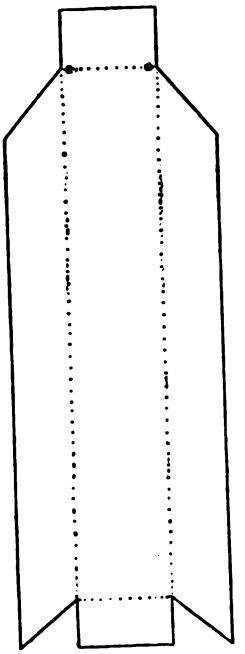
12. Body of tower : one-third scale. Use rule C



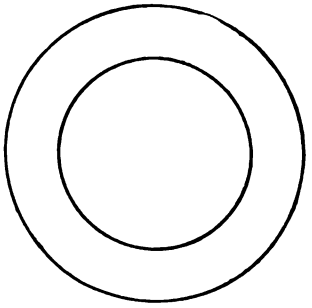
11. Washing and scrubbing towers



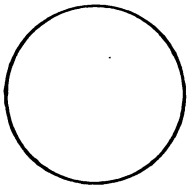
13. Tower top : half-scale. Use rule B



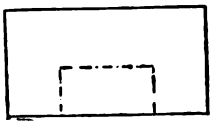
17. Stair : half-scale. Use rule B



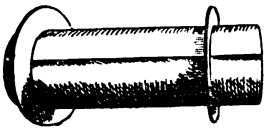
14. Tower rings : half-scale. Use rule B



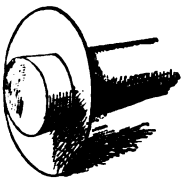
15. Tower disc : half-scale. Use rule B



16. Stage : half-scale. Use rule B

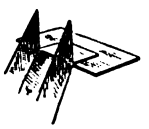


18. Making one of the towers



19. End of tower closed

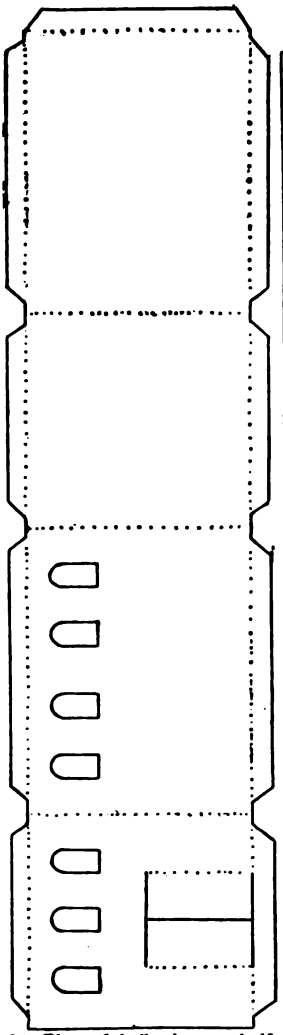
21. Stair for tower



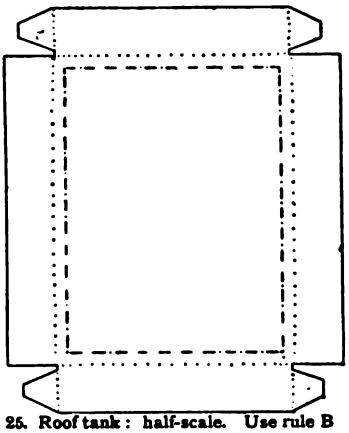
22. Stair-top and landing stage

23. Engine, boiler, and pump houses

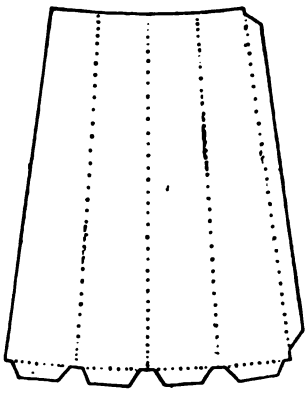
20. Cone-top for tower



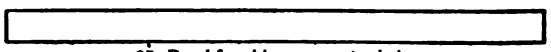
24. Plan of boiler-house: half-scale. Use rule B



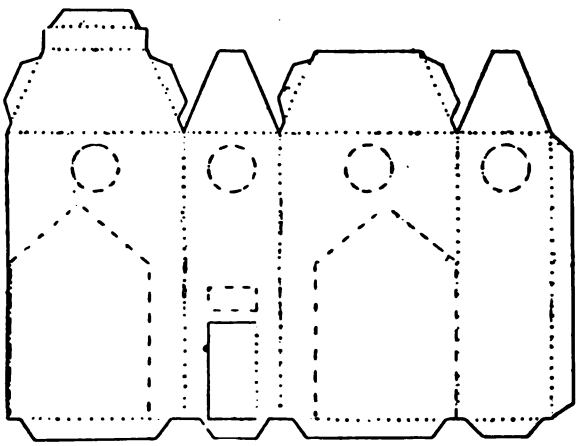
25. Roof tank: half-scale. Use rule B



26. Chimney: half-scale. Use rule B



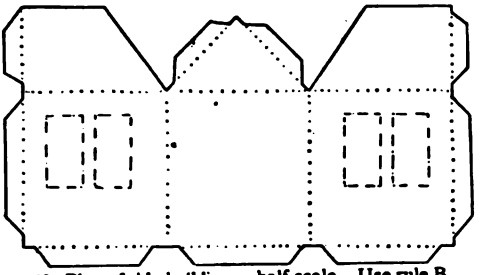
27. Band for chimney: actual size



28. Plan of engine-house: half-scale. Use rule B

be half-cut and bent on the back of the card. We have now all the pieces for the towers, and have only to put them together. It is quite easy to make the towers themselves. Roll up one of the pieces made from picture 12, and put the roll inside two of the rings made from picture 14. The long piece will tighten itself up inside the rings as seen in picture 18. With a pencil, mark the side where one edge overlaps the other under the rings. Take the card out of the rings and apply glue to the part that was hidden, and glue the piece up into the form of a tube, making it retain its circular shape. Glue together two of the six discs made from picture 15, and when they have set hard glue them into the bottom end of the tower we have made, as seen in picture 19. Glue one disc into the top end of the cylinder in the same way. Take one of the pieces made of thin card or thick paper from picture 13, bend it around and glue it into the shape shown in picture 20, and then glue it on top of the cylinder we have made. Finally glue one of the rings made from picture 14 outside the cylinder near the top, just at the dotted line shown in picture 12. One tower is complete, and we proceed to make the other in exactly the same way. We have now two cylinders or towers with closed ends, with conical tops and with a gallery running right round near the top of each tower.

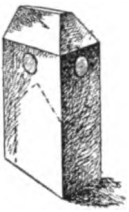
We have already made a piece from picture 16. We glue this piece, which forms a landing stage, to the rings on the two towers, as seen in picture 11, and then we glue to the middle of the landing stage the stairway or ladder that we made from picture 17. The stairway is seen ready to be fixed in picture 21, and the method of joining the stair and the landing stage is shown in picture 22. The pair of towers complete



29. Plan of side buildings : half-scale. Use rule B

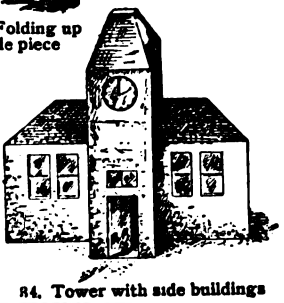
30. Top of tower : half-scale. Use rule B

31. Folding up tower part

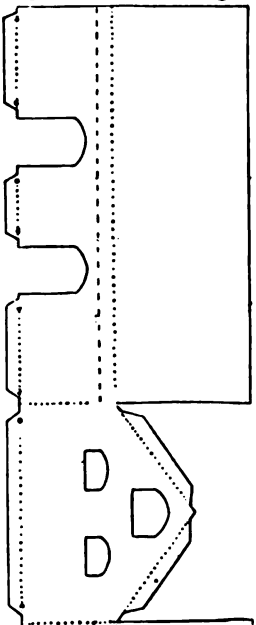


32. Tower part glued up

33. Folding up side piece

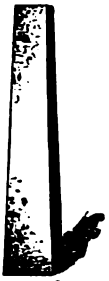


34. Tower with side buildings

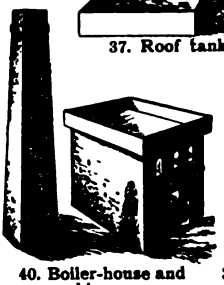


36. Boiler-house

37. Roof tank



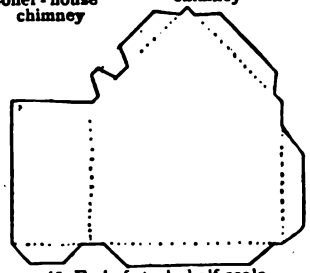
39. Boiler-house chimney



40. Boiler-house and chimney

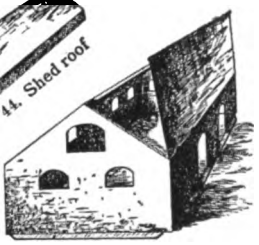
38. Boiler-house and tank

35. Top of tower

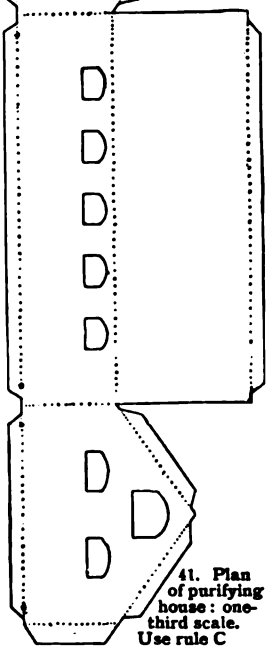


45. End of shed : half-scale. Use rule B

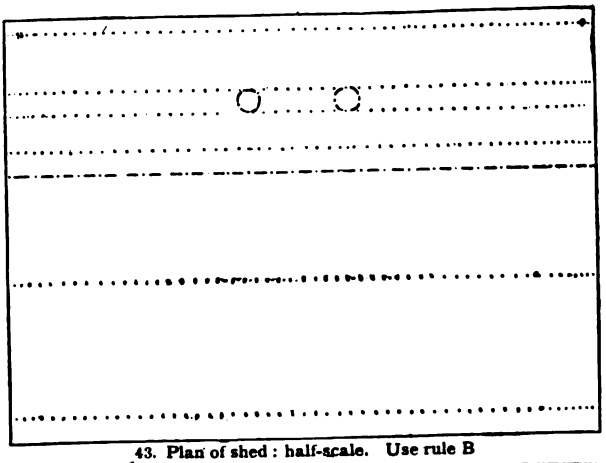
44. Shed roof



42. Purifying house

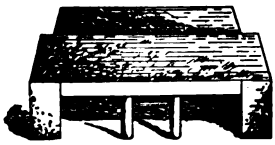


41. Plan of purifying house : one-third scale. Use rule C

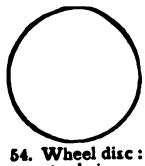


43. Plan of shed : half-scale. Use rule B

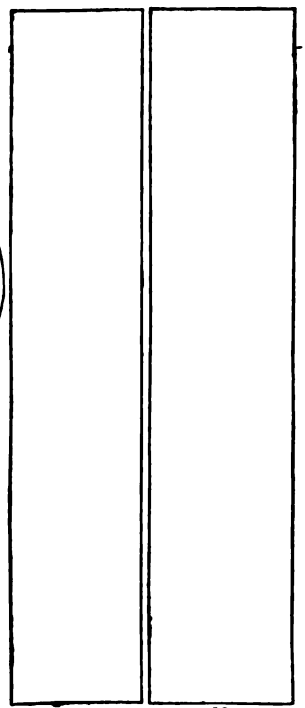
46. End of shed



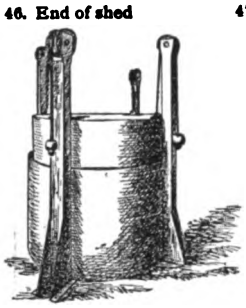
47. Front of shed



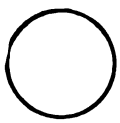
54. Wheel disc: actual size



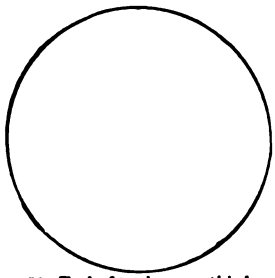
49. 50. Plan of tanks: one-fourth scale. Use rule D



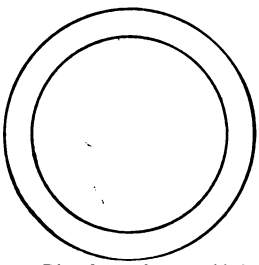
48. Gasholder



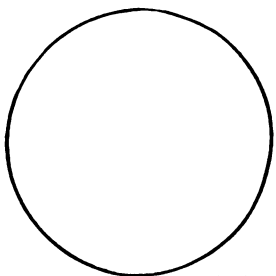
55. Wheel disc: actual size



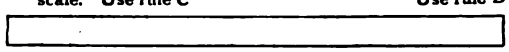
51. End of tank: one-third scale. Use rule C



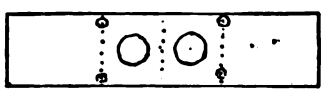
53. Ring for tank: one-third scale. Use rule C



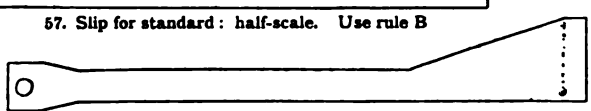
52. End of tank: one-third scale. Use rule C



57. Slip for standard: half-scale. Use rule B



58. Cord attachment: actual size



56. Size of standard: half-scale. Use rule B

with the landing stage and the stairway by which it is reached are seen in picture 11.

Pumps are necessary to force the gas through pipes, up into the scrubbing towers against a stream of water that washes it, and through other purifying houses into the great gasholders or gasometers that we know so well. The pumps require engines to work them, and the engines require steam boilers to supply the steam that gives them their power. For all these things some buildings must be provided, and there must also be a tall chimney to give a good draught for the boiler fires. This group of buildings is shown complete in picture 23, and we shall make it next.

We make drawings from pictures 24, 25, 26, 27, 28, 29, and 30, making two of 29, but only one of each of the others. Picture 27 is actual size, so that we use the full-sized rule both to take the sizes from the picture and to make the drawing on the card; all the others are half-scale, so that we use scale-rule B to take our sizes when making drawings from them. We may draw four clock-faces within the four circles on picture 28. The high tower with the two low buildings seen on each side of it in picture 23 is the engine and pump house. The building with the large tank on top is the boiler-house, and the tall chimney is at the far end of it. We shall shape and make the tower part first; it is the part made from picture 28. When being bent into shape it will be like picture 31, and when completely glued up it will be like picture 32. Then bend up, as shown in picture 33, the two side buildings made from picture 29. The tower part with the two side buildings will now look like picture 34. But there is still a top for the tower. The additional part we have already made from picture 30, and we glue it to the top of the tower in the manner shown in picture 35. When we have done this the tower will be complete, as seen in picture 23.

The boiler-house is of very simple construction. The walls are formed of the part we have already made from picture 24. When bent and glued into shape it will be as seen in picture 36. The roof tank has been already drawn from picture 25, and cut out. When folded up and glued into shape it will look like picture 37; and when glued to the top of the walls the whole will be as

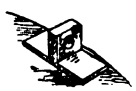
seen in picture 38. The tall chimney was made from picture 26, and must be folded and glued into the shape shown in picture 39. We have already cut out a slip made by copying picture 27. This piece must be glued on round the chimney near its top, as seen in picture 40. We must now get a piece of strawboard of suitable size, and, using it as a foundation, glue to it the engine and pump house, the boiler-house, and the chimney—all in the positions seen in picture 23. Note that the chimney is not put right up against the boiler-house. Picture 40 shows the boiler-house and the chimney fixed down their proper distance apart. We have now completed this section of our gasworks.

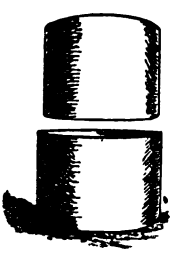
From the pump-house the gas is forced through pipes to the purifying house, which contains large boxes of lime or iron ore. The gas goes through these boxes, and, leaving behind in them the sulphur that it contains, it passes to the large gasholders. We could make these purifying boxes, but as they would not be seen from the outside we shall make only the building in which they are contained. Its plan is given one-third scale in picture 41, so that we use scale-rule C in taking the sizes from the picture. It is a building with doorways but no doors, and with window-spaces but no windows. When being bent up and glued into shape it will be as seen in picture 42. We now make an open shed—with a roof and side walls but no front—in which the earth for the purifying boxes may be stored. The plan of the shed is given in picture 43. It is half-scale, so that in taking the sizes for it we use scale-rule B. Notice the lines that must be half-cut and bent on the back of the card. When bent into shape the roof of the shed will be as seen in picture 44. The shed has closed ends, which we cut from picture 45, which is half-scale, requiring the use of scale-rule B for taking the sizes. We make two pieces like this, but one of them we half-cut and bend on the reverse side of the card. Now we glue the roof of the shed to the back of the purifying house, and we glue the ends of the shed into place, as seen in pictures 46 and 47. Picture 47 shows also two pillars in front. We have seen, in making the chapel and other buildings, how to make pillars, so that it will not be necessary to give plans for the two pillars for the shed.

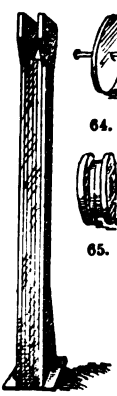
The last important part of the gasworks is the gasholder, which is seen finished in picture 48. It consists of an outside and an inside tank, the former fixed to the three upright pillars, and the latter working inside the former with the assistance of weights as shown. The bodies of the two tanks are made from pictures 49 and 50, both of which are one-fourth scale, so that we must use scale-rule D in taking the sizes from the pictures. They should be made on very thin card or thick paper, as they will then bend into circular shape more easily than they will if made of thick card. From thicker cardboard we make two discs from picture 51, two discs from picture 52, and one ring from picture 53. All these three pictures are one-third scale, so that we use scale-rule C to take the sizes from the plans. We also make eight discs from picture 54, and eight from picture 55; both of these pictures are actual size, so that we merely trace each of them eight times on thick card, and then cut them out. Then we make eight pieces from picture 56, and sixteen from picture 57, both of which are half-scale and require the use of scale-rule B to take the sizes from the pictures. In making the pieces from picture 56, we half-cut and bend four of them on the back of the card. Finally, we make four pieces like picture 58, which is actual size, so that we can trace them. In bending these last pieces into shape we must notice that the half-cuts and bends are in each case on the back of the card.

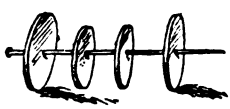

59. Making the tank


61. Upper bell with ring


62. Cord attachment


60. Tanks completed


63. Standard

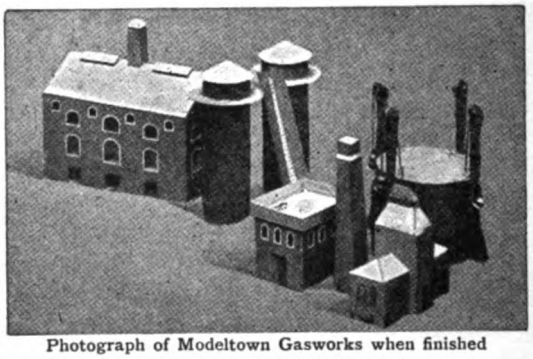

64. Making the wheels


65. Wheel

We have now prepared all our material for the gasholder, and may now proceed to put it together. First, we glue together the two discs made from picture 51, so as to make one stout disc, and we glue together the two discs made from picture 52, so as to make another stout disc. Take the glued discs made from picture 51, and roll it up evenly inside the thin cardboard or paper shape made from picture 49, so that the edges of the overlapping cardboard fall exactly together. This operation is illustrated in picture 59. Mark where the inner end falls upon the cardboard; glue the inside of the outer end from the pencil-mark to the end and roll the piece up again without the disc, holding it firmly until the glue has set. Now glue the disc we have been using into the end of the cylinder, by first putting a thin band of glue along the edge of the cylinder inside, and then by pressing the disc into position, so that it is quite level with the end of the cylinder. Now make the other cylinder which was cut from picture 50, and the two discs which were made from picture 52 and were afterwards glued together, to make one thick disc. We have now two cylinders with closed ends, as seen in picture 60, one of them being able to slip within the other. Upon a piece of cardboard of suitable size we now glue down the larger cylinder by its bottom or closed end.

The closed end of the upper cylinder is its top. With glue fix the cardboard ring made from picture 53 inside the upper or smaller cylinder, as seen in picture 61. The two cylinders are now complete. We have still to hang one into the other, so that it can rise and fall easily, and so that the upper cylinder will be so nicely balanced as to remain suspended at any position within the other.

Upon the top of the larger cylinder or bell mark on the rim four points at equal distances apart. Bend up the four pieces made from picture 58, and glue them into the shape shown in picture 62. Glue them to the four points marked on the rim and into position as shown is picture 62. Now we shall make the pillars or guides as seen in picture 48. Take four of the sixteen strips made from picture 57 and glue them together face to face so as to make one very thick piece. Treat the other twelve pieces in the same way, thereby making in all four thick standards. To each standard glue two pieces made from picture 56, so that, when finished, we shall have four complete standards as in picture 63. Now glue the four completed standards to the foundation board, making one standard exactly opposite each cord attachment.

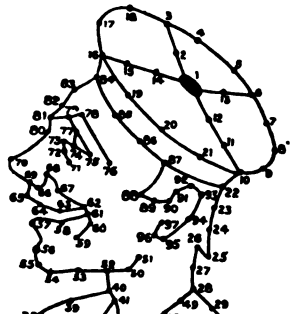


Photograph of Modeltown Gasworks when finished

We have already made eight discs from picture 54 and eight from picture 55. Take two of each and put a pin through the middle of all four, the two larger being at the outside, as seen in picture 64. Glue the faces of the inner discs and then press all four together, as seen in picture 65. The glue on the disc had better be allowed to harden while the discs are under pressure. If a copying press is convenient it may be used, but if not then a weight of books may be placed on the top until the glue is quite set. Treat the remaining small discs in the same way and we shall have four little flanged wheels. Get four circular wooden matches and cut off four pieces a little longer than enough to go from side to side of the pillars seen in picture 63. Make through the four wheels, right in the middle, holes large enough to take the wooden matches. Put the wheels within the tops of the standards and then put the cut-off matches right through the standard holes and the wheel holes. Tie a cord to each of the four cord attachments fitted to the top of the upper bell, and put the cords over the wheels. We have now only to provide the weights. Pierced shot such as is sold for fishing is the best sort of weights. It may be purchased at any fishing-tackle shop. We put one or more pieces on the free end of each cord so as to make the weights balance the rising and falling bell. It remains only to put the sets of buildings together and to paint them where painting is desirable. The gasholder and its pillars should be painted red; all the other buildings may remain white, except the tower of the engine-house and the roofs of the other buildings, which may also be made red. It would be a good thing to put a fence right round the gasworks. The designing of the fence we can leave to the little builders of Modeltown.

SOLUTION OF THE PUZZLE OF THE LAUGHING SAILOR

THERE are, altogether, 14 ways in which the puzzle of the sailor's face on page 2568 can be done. The dots have been numbered, and the order in which we pass them in the different solutions is as follows:



I. 1. 12. 11. 10. 22. 23. 24. 25. 26. 27. 28. 49. 48. 47. 46. 45. 35. 36. 37. 38. 39. 40. 52. 50. 51.

II. 1. 12. 11. 10. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 44. 43. 41. 40. 52. 50. 51.

III. 1. 14. 15. 16. 84. 83. 82. 81. 80. 70. 69. 66. 68. 67. 62. 61. 58. 57. 56. 55. 54. 53. 52. 50. 51.

IV. 1. 14. 15. 16. 84. 83. 82. 81. 80. 70. 69. 65. 64. 63. 62. 61. 58. 57. 56. 55. 54. 53. 52. 50. 51.

V. 1. 12. 11. 10. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42.

VI. 1. 14. 15. 16. 84. 85. 86. 87. 22. 23. 24. 25. 26. 27. 28. 49. 48. 47. 46. 45. 35. 44. 43. 41. 42. 20. 19. 16. 84. 83. 82. 81. 80. 70. 69. 65. 64. 63. 62. 61. 60. 59.

VII. 1. 13. 6. 7. 8. 9. 10. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 44. 43. 41. 42.

VIII. 1. 14. 15. 16. 17. 18. 3. 4. 5. 6. 7. 8. 9. 10. 22. 87. 86. 85. 84. 83. 82. 81. 79. 78. 76.

IX. 1. 2. 3. 18. 17. 16. 19. 20. 21. 10. 22. 87. 86. 85. 84. 83. 82. 81. 79. 77. 75. 74. 73. 72. 71.

X. 1. 12. 11. 10. 9. 8. 7. 6. 5. 4. 3. 18. 17. 16. 84. 83. 82. 81. 79. 77. 75. 74. 73. 72. 71.

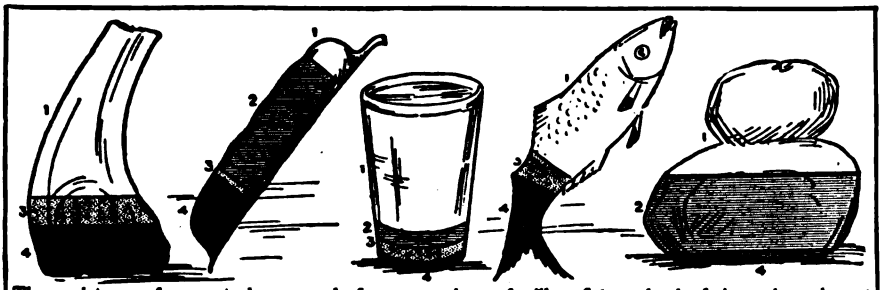
XI. 1. 13. 6. 7. 8. 9. 10. 21. 20. 19. 16. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97.

XII. 1. 13. 6. 5. 4. 3. 18. 17. 16. 19. 20. 21. 10. 22. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97.

XIII. 1. 13. 6. 7. 8. 9. 10. 22. 87. 86. 85. 84. 83. 82. 81. 80. 70. 69. 66. 68. 67. 62. 61. 60. 59.

XIV. 1. 13. 6. 7. 8. 9. 10. 21. 20. 19. 16. 84. 83. 82. 81. 80. 70. 69. 65. 64. 63. 62. 61. 60. 59.

THE NEXT THINGS TO MAKE AND THINGS TO DO ARE ON PAGE 2765



These pictures of a meat chop, a pod of peas a glass of milk, a fish, and a loaf show the value of these foods to the body. The parts marked 1 are water; 2 and 3 are carbohydrates and fats, which give the body energy and warmth; and 4 is proteid, which rebuilds the body as it wears out.

FOOD AND ITS USES

CONTINUED FROM 2628

WE have already seen that muscles are the furnaces where fuel is turned into work, and the ordinary name for muscle-fuel is, of course, food. By far the greater part of the food which we daily consume is for the use of the muscles, including the heart and the muscles of breathing, as well as the muscles of locomotion, and of the arms. Now, we have already learnt something about the machinery which exists in our bodies for taking in food and changing its useful parts, so that they can enter the blood and be carried by it to every part of the body. And here we must go on to find what food is made of; to learn what it is that makes bread a good food, and firewood no food at all; and how we may be guided in our choice of what we eat.

First, as the body is a furnace and a machine, making power or work out of fuel, it must be supplied with something that will burn, and with enough of it. The fuel supplied must not merely be burnable outside the body, when a flame is put to it, or when it is thrown into a furnace, but it must be burnable inside the body, at the temperature of the body, which is very low compared with that of even a tiny flame. Now, firewood will burn—that is to say, the elements of which it is made are not combined with as much oxygen as they would like, and will take more if they can. But firewood will not burn at the temperature of the body—or, indeed, at temperatures a great deal higher. So, though it is fuel for a furnace, it is not a fuel or food for man. The same is true of coal. It consists mostly of carbon, and our bodies burn large quantities of carbon every day; but coal, as charcoal, will not burn at the low temperature of the human body. We may take charcoal powders, and eat charcoal biscuits, but not a single atom of the carbon in them combines with oxygen in our bodies. It may be a medicine, but it is not a food.

Suppose, now, we knew that the body must have carbon to burn, and had to find out how to give it the carbon it requires. Wood, coal, charcoal, we find, are useless, if we try them. Plainly, we must try some of the compounds of carbon, compounds which contain less oxygen than will satisfy the atoms in them. Carbonic acid gas, for instance, would not do, for that is fully burnt up already. Now, one of the cheapest compounds of carbon is starch, and perhaps that will meet the body's need. We think of starch as something to make clothes stiff, but it is one of the most important of man's foods.

Knowing, as we do, that all the world of life is knit into a whole, that animals depend on plants, and plants on animals, we should expect starch to be useful, when we know that every green leaf everywhere is

making starch whenever light falls upon it. If you take a leaf, before sunrise, and clamp a little part of it with a pair of flat corks, and then, at the end of the day, take the corks away, wash the leaf in alcohol, and add a little iodine to it, the whole leaf will turn blue except at the spot which the corks covered. That spot will be white. The reason is that the leaf has been making starch in itself all day, except where the corks prevented the light from reaching it. The alcohol washes away the green chlorophyll from the leaf, and then the iodine, which is the test for starch, reveals it by turning the leaf blue where starch is present. Do not apply this test for starch by spilling tincture of iodine over a shirt-front; but if you do so accidentally you will have no doubt about the blue colour made when starch meets iodine.

This experiment is worth describing here, even although we are talking about food, because it is possible to measure how much starch the leaves make.

THE GREEN LEAVES THAT ARE ALWAYS AT WORK FOR US

We know how much starch we require every day, and so it is possible to say how much foliage must be at work every day for every human being, not to mention the lower animals. One square yard of leaves will produce about fifteen grains of starch in an hour. If you and I are to get all the fuel we need to-morrow, each of us requires to have 500 square yards of leaf working for an hour—or, say, 100 square yards working for five hours. That, we understand, is just an average. The exact figure would vary with the intensity of the sunlight falling upon the leaves, the amount of work we did in the day, the size of our bodies, and so on. But it is well that we should think of ourselves as daily dependent upon a multitude of green leaves somewhere, which are translating the energy of sunlight into a form that we can use.

But if we take starch outside the body, and heat it in the air to the temperature of our blood, we do not find that it burns. The same is true of sugar and bread and meat, even when they are completely freed from water. Yet all these things burn inside the body, and are foods just because they do so. We find that the body has within itself the power of causing things to burn under conditions of temperature, and so on, in which they would not burn outside the body. This is done by means of chemical substances called ferments, which exist in the blood and in every living cell in the body.

So far we have thought of food as simply fuel for our engines, the muscles, that have work to do. But the food has other uses, and we need other kinds of food besides those that are simply fuel.

THE FOODS THAT FEED THE FURNACES OF OUR BODIES

These other kinds of food we must learn about, but we have purposely begun with the question of fuel-foods, because by far the greater part of the whole bulk of our food is required as fuel; and also because we know more about the uses of food as fuel than we do about its other uses. We must also recall what was said on page 2626 about the contraction of a muscle. The furnaces of the human body are required not only to produce work, but also to produce heat. Thus we owe to the burning of our fuel-foods all the work done by our muscles, visible and invisible, and all the heat which is made by our bodies. It is these two needs that account for the great quantity of fuel we require, and for the frequency with which the supply of it has to be renewed. If it fails, our temperature very quickly begins to fall.

But now we can look at foods more generally, to see what other purposes they serve than those of fuel. Let us consider our bodies, and ask what are the things that they get every day from outside themselves. Let us mention everything, whether we are accustomed to look upon it as food or not.

THE VALUE OF AIR AS FOOD, AND HOW WE MAY HUNGER FOR IT

The things that our bodies receive daily from the outside world are: air, water, light, salts, fuel-food, and proteids.

1. AIR. We do not think of air as a food, yet there is no more reason for calling the carbon food than there is for giving the same description to the oxygen which is to combine with the carbon in our bodies. Any proper idea of what is meant by food must certainly include air, or, rather, oxygen. It is incessantly being used up in our bodies, and new supplies are always needed. It is possible to be *hungry*, too, for this very valuable food; and in some kinds of illness, where enough oxygen can hardly

get into the blood, it is terrible to watch the unhappy person's "air-hunger," as the Germans quite properly call it. People are very likely to have fads about their food. It is a pity they cannot learn to be more particular about the quality and purity of their air-food, or of that which they condemn other people to live upon.

ALL OUR LIVES ARE LIVED, AND MUST BE LIVED, IN RUNNING WATER

2. WATER. The second thing which our bodies receive every day from without is water. We do not often think of this as a food; but there we are wrong. By far the greater part of our bodies consists of water; and it is a specially notable thing, as true of an oak or a microbe as it is of ourselves, that, for life, there must be a ceaseless circulation of water. Not merely is all life lived in water, but it is all lived, and must be lived, in *running water*. No matter what kind of living creature we examine, we find that it is always *giving off water*, and unless this loss is supplied it will soon cease to live. Few things in Nature are more wonderful than the giving off of water—a sort of perspiration—by the leaves of a plant, and the way in which the roots drink the water from the soil and send it up to the leaves. But the same process is going on in ourselves. On an average each one of us loses about six pounds of water every day of our lives by the action of the skin, the lungs, and the kidneys. Of course, this means that the same amount of water must be taken into the body somehow every day; and thus there is no more necessary or important food than water.

THE GREAT NECESSITY FOR WATER AND THE TERROR OF THIRST

We can learn a good deal from the very unpleasant feats performed by fasting men. If a man can store up in his body anything he needs, then he can do without fresh supplies of it for a time. We cannot store up oxygen to last us for more than a few minutes. But we can store up enough of the fuel kind of food, especially in the form of fat, to last quite a long time. A man may go quite without eating for forty days, but that is because his body is, during all that time, using up the fat that it has stored. But no man can store up water in his body, and so the fasting man always has to be allowed as much of this food as he pleases, just as he has to be allowed oxygen. Not even the fasting man, then, is an exception to the universal law of all living matter, that it must have an unfailing supply of fresh water supplied to it, in order to keep going that stream of water in which all life everywhere is lived.

This helps us to understand how it is that thirst is so terrible, and why living creatures, suffering from thirst, will drink the most horrible things if there is no other way in which they can get water. We understand, also, why madness follows upon lack of water after a very short time, as we know in the case of shipwrecked sailors. Children live very quickly, so to speak, for they are naturally very active, and, unlike grown-up people, they are growing fast. They need a frequent supply of water, and suffer very severely if it is not forthcoming.

THE POWER OF WATER AND LIGHT AND SALT IN KEEPING US ALIVE

There are few things more cruel than to deprive a child of water, or to expect it to learn its lessons well when it is thirsty. A child's brain cannot act properly if the blood does not carry sufficient water to it. Doctors, also, have lately learnt that, when Nature demands water for a feverish child, Nature must be obeyed.

In most books water is not reckoned to be a food because it is not burnable—it is, of course, already burnt—and because it does not go to make any of the tissues or stuffs of the body. But, as every living tissue is itself built up and lives on water, and as this water must never be allowed to become stagnant, it is plain that we ought to regard water as one of the most important of all foods.

3. LIGHT. Another of the things that enter our bodies is light. Under this we may include not only the visible light that strikes the eyes and the skin, but also all kinds of invisible radiation from the sun and from the atoms of the air, which also strike and enter our bodies. These things have power and energy in them; they do enter our bodies; and we know that nothing is ever lost. Something must happen to them, and the fact that they enter the body just

as surely as air, or water, or bread, does, should not be forgotten. Up to the present, however, students of the body have not studied this subject.

4. SALTS. The case of the salts proves to us at once that a thing may be a food even though it supplies no power to the body, not being burnable food, and even though it does not make tissues. Certain salts are absolutely necessary for life, and as they pass by no means slowly away from the body, the supply of them needs to be constantly renewed. We do not yet know nearly all their uses in the body, but we know some. Several kinds of salts are necessary, though there is only one kind—common salt, or sodium chloride—that we actually add to our food. The other kinds are sufficiently supplied by their natural presence in food. We need lime salts, for instance, and there is actually more lime in milk than there is in lime-water. Vegetables and fruits are principally of value because of the salts they contain. When we cook a cabbage we dissolve into the water the most valuable part of it—the salts it contains—and then throw the water away! Meat also—that is, the muscles of ox or sheep or pig—contains a great deal of salt; but of all our food-stuffs fruit is best so far as salts are concerned.

THE USES OF SALT AND THE PART IT PLAYS IN OUR LIFE

We look upon common salt as a thing to flavour food with, like mustard and pepper. But, while these are not foods at all, salt is a necessity of life. Not only does it play a necessary part in the blood and the tissues, in a way we do not yet understand, but it is the source of one of the important products of the stomach, without which the digestion of our food would be difficult or impossible. If we remember that common salt is sodium chloride we shall understand at once that it is the source of the hydrochloric acid which is poured into the stomach some twenty minutes or half an hour after every meal we eat.

If the body of an animal or a human being be burnt, we find that there is always left an ash; and this ash consists of the salts that were in the body and that cannot be burnt. Important among them would be the salts of lime, which give strength to the bones and to the teeth. If a bone be placed in an acid, and the salts melted away, the bone becomes quite soft, and can be tied into a knot. So these salts are specially important as part of the food of babies and children who are making their bones and teeth. Salts of iron, too, are necessary for the blood, and it is easy to prove that there is a rich and constant supply of salts of iron in milk.

THE THREE FOODS THAT MAKE UP THE CHIEF PART OF OUR DIET

5. FUEL-FOODS. And now we come to the foods which make up the bulk of our diet, and are all burnable. They are of three kinds and no more—*carbohydrates*, *fats*, and *proteids*. Carbohydrates is the name given by scientists to compounds containing carbon, combined with hydrogen and oxygen; and proteids are the important compounds containing carbon, hydrogen, oxygen, nitrogen, and sulphur, that are found in all animals and vegetables. Of the three foods, the first two—carbohydrates and fats—are pure fuels and nothing else; they are burnt in the body, making heat and power. The fat can be stored in large quantities, and the body can turn either carbohydrates or proteids into fat if it desires to store them up, as often happens when we eat more than we have present need for. But the body cannot store up carbohydrates in any quantity, and cannot store up proteids at all. Here it differs from the body of a plant, for that can store up its food as a carbohydrate—namely, starch. The wax which bees make out of sugar is a case of a carbohydrate—sugar—being turned into fat.

THE FUEL-FOODS THAT GIVE US HEAT AND POWER

Most of the fat we eat is of animal origin, such as the fat of meat, the fatty part of the yolk of an egg, and the fat in milk, cream, and butter. All these forms of food are expensive compared with most vegetable food, and it is the vegetable world that gives us most of the carbohydrates we eat—sugar and starch. It seems to matter nothing at all to the body whether its fuel be supplied as fat or as carbohydrate; but perhaps sugar, if not starch, has the advantage over fat, that it is more easily digested, besides being much cheaper. There is no doubt which Nature prefers for children; though, if we are careful, children

will take more fat than is sometimes supposed. The best form of fat for children is also the dearest—cream.

Unlike any of the things we have mentioned hitherto, such as air, water, and salts, the pure fuel-foods, sugar, starch, and fat, are not necessary for life. It is possible to live without ever taking the smallest quantity of any of them. This is so because it is possible to burn proteid food, and use it as fuel. Fuel, of course, we must have in some form or other. But it would be very unwise for anyone to use proteids only as his fuel-food, and to give up the carbohydrates and the fats. In the first place, the proteids are very much more expensive; secondly, they require much more digestion, on the whole; and thirdly, when the proteids are used as fuel-foods they do not burn up completely into water and carbonic acid, as fat and sugar do, but they produce all sorts of other substances which it is very bad for the body to produce in it from day to day. In time they poison the body and make it "old," as we say; and that is what happens to people who live to eat, and so do not take a natural diet, with a natural balance of the various kinds of food in it.

THE FOOD THAT BURNS AWAY OUR BODIES AND THE FOOD THAT REBUILDS THEM

For immediate result, and simplicity of digestion, sugar is undoubtedly the best fuel-food. That is why children, who are so active, and are specially in need of heat-producing foods owing to their small size, are naturally so very fond of sugar and sweet things. If a child is always allowed just as much sugar as it feels inclined for, it does not make itself ill with eating too many sweets, as children do who have been unwisely starved of sugar.

Now we may leave the carbohydrates and fats, remembering that while they must take a second rank as foods because it is possible to live without them, yet they are exceedingly useful and valuable; and probably to take more of them than we really need is not nearly so harmful as it is to take more than we need of proteids.

6. PROTEIDS. Proteids are the last class of foods that we need, and there is something special about them which, in a way, raises them above all other foods in importance. We have described the body as a sort of engine which needs fuel, and so it is. But it is a living engine, which itself is burning and being destroyed from day to day. If it is to go on living, as, indeed, it does so well that no engine made by man can compete with it for lasting power, it must be supplied with food which will make good its wear and tear; and the only food which will do this is proteid.

THE FOOD THAT EVERY LIVING CREATURE NEEDS TO REPAIR ITS BODY

Every living creature requires a supply of proteids to make good its wear and tear; but only one kind of living creature, those that have chlorophyll, can make proteid for themselves. All others, including all the plants, like mushrooms, that have no green chlorophyll, and all animals and human beings, must have ready-made proteid supplied to them. There are many different kinds of proteids, but most of them are suitable food for us, whether they come from the animal or the vegetable world. They are changed by digestion into the special kind of proteid that is found in our blood.

However richly a man were supplied with water, salts, starch, sugar, and fat, he could not live without proteids. But we should clearly understand that the proteid is required not as fuel, for sugar and starch are better fuels, but as a means of repairing the body waste. Proteid can be used as a fuel if necessary, so that it is possible to live without fats or carbohydrates, as we have seen. Very many people take far too much proteid food, especially in the form of meat. They take it simply because they like it; but they do not know the consequences.

HOW POISON MAY COME INTO OUR BODIES THROUGH OVER-EATING

If sugar and starch and fat are taken in excess, they can be stored up as fat. It is a peculiarity of proteid that it cannot be stored. It must either be used, or broken up and got rid of; and that is what happens when we take more proteid than we need, as most well-to-do people do every day of their lives. Unfortunately, the breaking-up of proteid in the body is a difficult business, proteids being enormously complicated compounds, and many of the products of this breaking-up are mild poisons. If they are

being continually produced in the body, they gradually injure the health of the blood-vessels, and of the parts of the body which are concerned in getting rid of them. This is a very serious matter, and explains why continued over-eating produces its very evil consequences upon the body.

THE AMOUNT OF FOOD WE NEED AND THE CLOTHES WE WEAR

Of course, we ought to know about how much of these various things are required in our food every day. What we need varies very much according to many circumstances. In the first place it is certain that some people are more economical with their food than others; they can get out of a small diet as much work as other people will get out of half as much again. These are natural differences which cannot be explained. Also the size of the body affects its needs very markedly. The Japanese have small bodies, and apparently, as a race, are able to make a little food go a long way, even apart from the fact that they are small. In the Russo-Japanese War, one of the great advantages enjoyed by the Japanese was that their soldiers required very little food, while the Russians required a great deal.

Climate and clothing also affect the amount of food we need. In warm air we lose heat less rapidly, and so we require much less fuel. Our appetites are naturally lessened in hot weather, and if we are wise we respect the warning. If we are foolish we try to cheat our appetites with dainties. In very cold climates large quantities of heat-producing food are needed. Thus, the Eskimo lives largely on blubber, which is fat. Similarly, other things being equal, the more clothes we wear the less food we need.

HOW THE WEIGHT OF FOOD A MAN EATS DEPENDS UPON HIS WORK

Muscular work very greatly affects the quantity of food we need. This, of course, we know, must be so. The appetite of men doing really hard muscular work is very great. It has to be, if sufficient fuel is to be supplied to the muscular engines. Mental work scarcely affects the amount of food needed.

In all these cases, it is the quantity of the heat and work foods—fat and carbohydrates—that should vary. Circumstances do not affect so much the need for proteid food. Here are some figures giving an idea of the quantities of food required. A soldier is allowed, in this country, a pound of bread and three-quarters of a pound of meat a day, together with additions like salt and so on. When he is on active service he is burning more fuel, and so he is allowed one and a quarter pounds of bread and a pound of meat. Of course, these weights include a good deal of water; and in our food in general, not only is there naturally a great deal of water, but there is also a proportion which cannot be digested and is only waste matter. So the figures showing the weight of the food a man eats in a day are very different from those showing the quantities of actual food material by which he lives.

An average diet for a man would be about six pounds of water, one ounce of salts, fifteen of sugar or starch, three of fat; and as to proteid, probably three ounces is abundant, though twenty years ago a much higher figure would have been named. The quantities of all foods but proteid must be increased for severe labour, and very much lessened if a person is going to stay in bed.

WHY A BOY MAY REQUIRE MORE FOOD THAN A MAN

Of course, the figures vary in proportion to the size of the individual; but a small man requires far less food than a boy of the same weight. In other words, children need a quantity of food quite out of proportion to their weight, for while adults merely have to maintain their bodies, children are *making* their bodies. Children, therefore, require not merely a large supply of food in proportion to their weight, but they require a specially large proportion of proteid, for proteid alone, as we have seen, will actually make a living tissue. When we come to study the more important foods, we shall see how carefully Nature has supplied this need for proteid, in the food which she prepares for young human beings, and for all the young animals that belong to what are called the mammalia. Another special need of children is lime, for bones and teeth; and so we find milk rich in lime, and should give children plenty of foods that are rich in lime, such as eggs and oatmeal.

The next part of this is on page 2791.

WHAT THIS STORY TELLS US

ALL children who read this book are glad to know something about the great British race, whether they live in England, the United States, or in far-away lands where the English language is spoken. Now, there was a time when England and Scotland and Ireland were not one nation, so that each of the three has a history of its own. What we are going to talk about now is the story of some of England's kings who, in one way or another, helped to make her powerful and famous among the nations. For kings have done only a part of the work. In other parts of this book we may read about other kings, of whom some were bad and some were unfortunate; and about queens, and statesmen, and soldiers, and sailors, and teachers of men; for we ought all to know the lives of the men and women who made England what she is.

FAMOUS KINGS OF ENGLAND

Under Whom the Nation Grew to Greatness

CONTINUED FROM 2599

WHEN the Angles and Saxons had lived for some time in England, and had settled down to a peaceful life, there came a barbarous folk called the Danes, who harried all the places by the seaside, and then began to threaten not the coasts only, but the whole land. And though the Saxons fought stoutly against them, yet the Danes were fiercer and more skilled in war; and they conquered nearly all the north country, which was then called the Danelaw.

But they did not conquer the West Saxons, the men of Wessex, who dwelt south of the Thames and the Severn. Now, there arose a great king in Wessex, who fought against the Danes, and drove them back so far that they were forced to make peace, though they had no love of peace. And this king was Alfred, of whom nothing ill, but all good, is told, both for his skill and valour in war, and for his wise law-making, and for his learning, his wisdom, his justice, mercy, and courtesy. He is the king of whom it is told that at one time, when the Danes had beaten his army in a battle, he had to flee; and he came, all travel-worn and weary, to the cottage of a neat-herd—that is, a man who kept cows. The king asked the neat-herd's wife for food and shelter. But she, not knowing who he was, said he must work for his food and lodging, though, as he seemed so weary, he might sit by the fire and see to the cakes she was baking. But, as he sat, his thoughts went far away from the cakes to planning how he could gather his army again and free the land from the Danes, so that when the busy dame came back into the room the cakes were all burned and spoilt; and the king had his ears well boxed for being a lazy loon. Later, when she found he was the king, she was in a terrible fright; but he laughed and told her she had only treated him as he deserved.

Alfred gathered his men again, and beat the Danes, so that they agreed to own him as their overlord if he would leave them free in the Danelaw, and to that he consented. And Alfred taught the Saxons to build ships for fighting, and to set up fenced cities, and trained them for war, and sent also for wise men from overseas to teach them the arts of peace.

After his day there was more or less peace between the English and the Danes in England for a hundred years. But then there came more Danes, who conquered England. And after the rule of the great Danish king Canute and his two sons, the house of Alfred was restored to the throne. But the king, Edward

the Confessor, loved the lords of Normandy, which is in the north of France; and Duke William of Normandy said that both Edward and the Earl Harold promised that when Edward died Duke William should be king. But the English people made Harold king. Therefore, Duke William gathered a mighty army, and invaded England, and fought with King Harold at the battle of Hastings, and slew him. Then the English people owned Duke William for their lord.

THE NORMAN CONQUEROR WHOSE VICTORY PROVED GOOD FOR ENGLAND

Now, the new king, William the Conqueror, took away the lands of all who had fought against him, and gave them to his own followers from Normandy. And when the English folk rose up against him, he smote them utterly, being a very great soldier; and again he took away the lands of those who had rebelled, and gave them to his Normans, so that the country was covered with the castles of the Norman captains, who were called barons, and they ruled harshly. Nevertheless, the conquest was good for England, because the Normans had more skill than the English both in statecraft and in the arts of war and of peace; and as the years went by Normans and English became one people, though not till a long time had passed. United so, they became much mightier than ever the English would have been without the Normans.

This Duke William, who became King of England, was the greatest captain of his time, and smote his foes in many wars; and he was so strong that scarce any man could bend his bow. Yet though he was without mercy, it was his will to be just, and to compel his barons to do justice and right.

THE CONQUEROR'S SCHOLAR SON, AND THE GREAT GRIEF OF HIS LIFE

Moreover, William had a wise counsellor, Lanfranc, whom he made Archbishop of Canterbury. And although in those days it was the way of great lords to set their king or overlord at defiance, none did so to William without being punished, so that the barons feared him, and for the most part did his bidding.

After him reigned his son William, called Rufus, or the Red, who wrought evil all his days; and after him another son, Henry I., who was called Beauclerc, which means "fine scholar," because he loved learning and wisdom. In his latter years men called him also the Lion of Justice, for when there was peace in England he would not suffer his barons to wax proud and to do as they willed, but, like his father, the Conqueror, he held them in check with a strong hand. And he planned ways whereby it should be made easier for the common folk to come before the king's justices and have right done to them if the barons tried to oppress them. And though King Henry did this not so much because he cared for the common folk as because it would keep the barons from growing too powerful, yet it was the common folk who were the gainers. He had a son, Prince William, who should have followed him on the throne, but, as he was coming overseas in the White Ship, he was drowned; and Henry was very sad ever after.

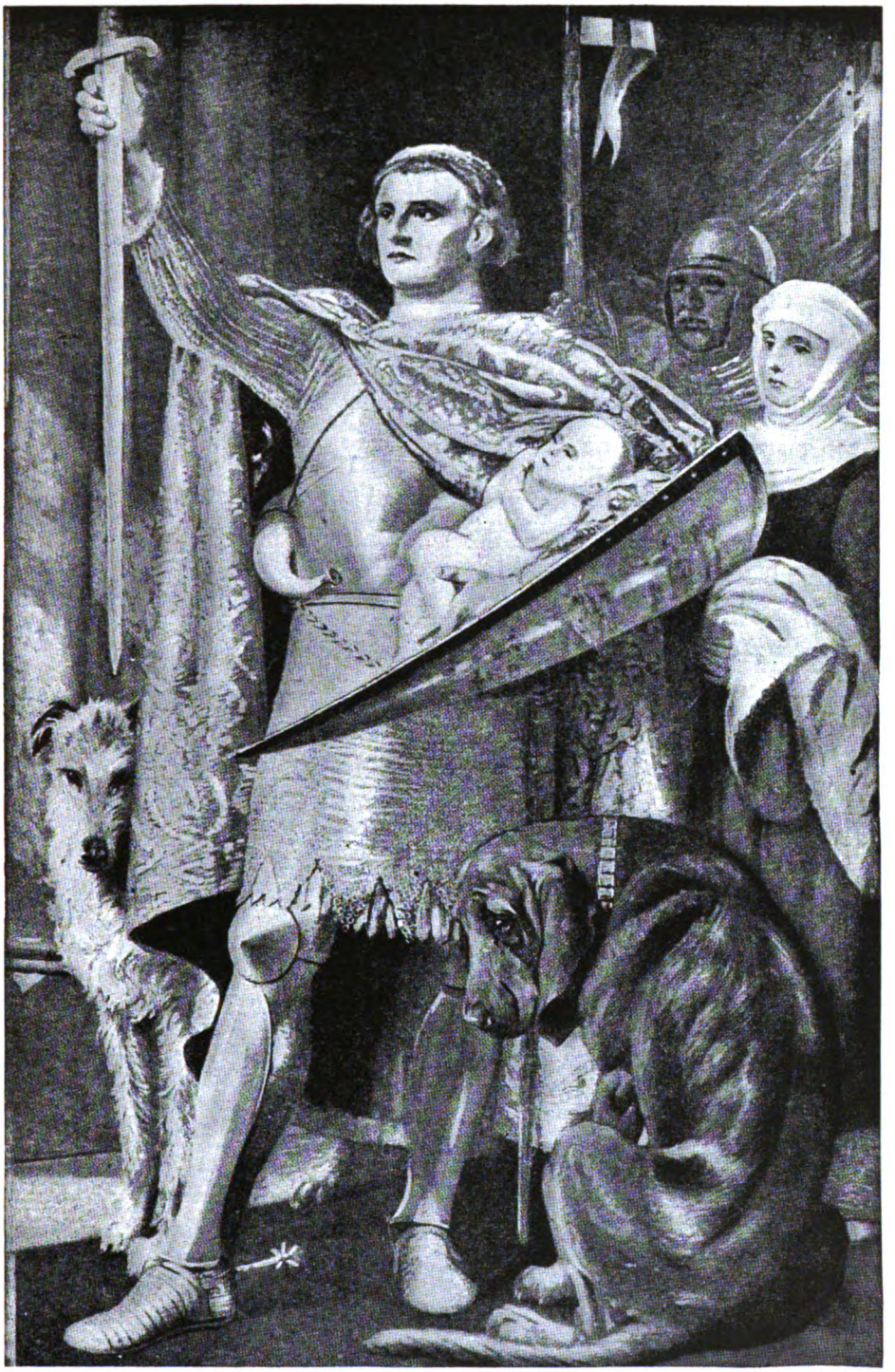
Now, since Prince William was dead, Henry would have had his daughter, who had wedded the German Emperor (and so is called the Empress Maud) to become queen after him. But the Council of the State chose her cousin, Stephen of Blois, and for years there was strife between Maud and Stephen.

THE HOUSE OF PLANTAGENET, WHICH GAVE ENGLAND 300 YEARS OF KINGS

But at last they agreed that Stephen should rule till he died, and then Maud's son, Henry of Anjou, should become king. This was Henry Plantagenet—for so the counts of Anjou called themselves; and Henry was the son of Maud and of Count Geoffrey, whom she had married after the emperor's death. They bore this name, which means "broom plant," because they wore a sprig of broom on their helmets. And for more than three hundred years every king of England was a Plantagenet.

The first Plantagenet king, Henry II., was a very great ruler. For, besides being King of England, he was lord of half France, though not its king, owning Normandy and Anjou, and having as his wife the Duchess of Aquitaine. Yet, though he had to be much in France, he set England in such good order as she had not known before for many a year. For he broke down the power of the barons, who had paid no heed to the king in the days of

THE FIRST PRINCE OF WALES



King Edward I. won such successes in Wales that the native chieftains all submitted to him. Edward wanted to obtain the goodwill of the Welsh people, so he gathered their leaders together and told them that they should have a prince of Welsh birth. Then he presented to them his infant son, who had been born in Carnarvon Castle.

Stephen, and he restored the wise rules that his grandfather, Henry I., had made, sending judges to all parts of the land so that all men could win the king's justice and protection against oppression.

But he had a grievous quarrel with his friend, Thomas à Becket, whom he set at the head of the churchmen in England, making him Archbishop of Canterbury. For Becket set himself to be the champion of the rights and privileges of the clergy; whereas the king would have taken some of these from them, seeing that they were set apart from other folk, and had milder laws, and were apt to make their own authority greater than the king's. So the king and the archbishop quarrelled, yet after a long while they seemed to have become friends; till once again Becket stirred the wrath of Henry, who was very fierce and hot of temper, and he cried in his wrath: "Is there none who will rid me of this pestilent priest?" Whereupon four knights, who hated Becket, made haste to Canterbury, and slew the archbishop in his own cathedral. And Henry repented bitterly, and did penance; and because of that crime he dared no longer resist the claims Becket had made.

THE BITTER END OF HENRY II. AND THE WARS OF EDWARD I.

Now, Henry's later years were bitter, because his sons rose up against him, and he died warring against them. And after him Richard the Lion-Heart was king; but he saw little of England, for he was warring in Palestine against the Sultan Saladin, to win the Holy Sepulchre from the followers of the Prophet Mohammed. And after him was his brother John, who wrought evil all his days. And after John, in whose reign the barons won for the people of England the rights that made her a free nation, was his son Henry, who was king for more than fifty years. And after him came the great king Edward, who was called Longshanks by reason of his great limbs, and also the Hammer of the Scots, because of his Scottish wars. Edward was a great warrior, being both a well-skilled leader of armies and of great prowess in single combat. He conquered the Welsh, a small though valiant people, and he conquered Scotland; yet, though he could overthrow her armies, she rose against him again and again, and would have none of the English yoke, which Scotland cast off for good and all in the time of his unhappy son, Edward II.

THE GREAT WORK DONE FOR THE NATION BY EDWARD THE FIRST

However, the glory of Edward lay not in his conquests, for they came to little in the end, but his glory lay in this—that he resolved so to order the government of the country that the barons and the commons should each of them have so much voice in it that neither clergy nor barons could play the tyrant; and, besides making many good laws, he gave the Parliament of England the form which was scarcely changed for five hundred years. And so in some sort he made complete the work that Henry II. had done for England, the work that the barons had done in the time of John, and the work that his own father, Henry III., had done.

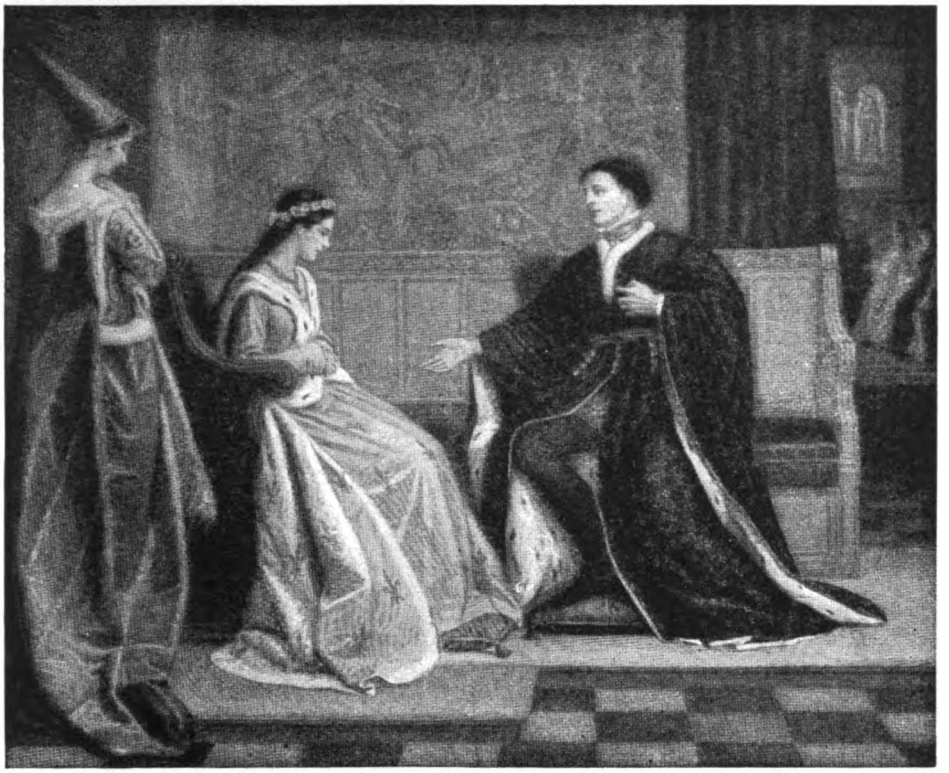
When he died, his son, Edward II., became king, but his days were troubled, and after twenty years he was dethroned and murdered; and his son, Edward III., became king in his turn, and he ruled for fifty years. In his day he was the most famous soldier in Christendom; and the English archers won renown for the victories which they gained under his leadership and that of his son, Edward, the Black Prince, over the chivalry of France. Most glorious of those victories was the battle of Cressy, where the English yeomen and English knights utterly overthrew five times their own number of Frenchmen. These wars were fought because Edward made claim that he was the true heir to the crown of France; but, in truth, what he wished for was to have his dukedoms in France freed from the overlordship of the French king.

HOW EDWARD III. WON NEW LANDS FOR ENGLAND AND LOST THEM AGAIN

In those wars he took the French town of Calais. Yet, though these great deeds of arms brought fame and glory, and seemed for a time likely to win all France for King Edward, they brought little gain to England in the end; for, long before he was an old man, Edward became feeble, and in his later years all was lost that had been won.

Trouble was the lot of his grandson, Richard II., who followed him on the

HENRY THE FIFTH & EDWARD THE SIXTH



When Henry V., who won the great battle of Agincourt, at last made peace with the French, one of the conditions was that he should marry the French king's daughter, Catherine. Here we see Henry wooing the French princess. Shakespeare, in his play of Henry V., has given an amusing account of the courtship, in which neither Henry nor Catherine understood the language of the other, but used Catherine's maid as an interpreter.

Edward VI. was a boy of nine when he became king. and according to his father's will, a council was to govern the kingdom until he came of age. But Edward did not live long enough to rule by himself. In this picture the artist shows us the kind-hearted boy king sitting with his councillors, hesitating to sign a death-warrant.

The top picture on this page is reproduced from the Art Journal.

throne; for the Black Prince died before his father. And after a time Richard's cousin Henry put him from the throne, and made himself king with the consent of the people. Yet he, too, had little peace; and in after days men said that he had much grief from the wild doings of his son Henry, who after him became King Henry V.

How Henry V. Marched into France and Married the King's Daughter

For it was told of this prince that in his youth he and his boon companions would play the part of highwaymen and other mad pranks. But, however wild the prince may have been, when he became king he set to work in grim earnest. For somehow he made himself believe that he had a right to the crown of France, which his great-grandfather, Edward III., had claimed, and all Englishmen were ready to fight the French. So they invaded Normandy, and captured the town of Harfleur.

But, seeing that he could not at once conquer France, Henry did not come back with his forces to England, but marched through Normandy towards Calais, with but a few thousand soldiers. But by this time the French had gathered a great host, and they stayed the English king's march at Agincourt. But Henry won there a victory even more wonderful than Cressy, and thereafter he gathered a fresh army in England and came back to France, and set himself to conquer all the northern part of the land step by step, until presently the French king made a treaty with him that Henry should wed his daughter Catherine, and should be heir to his throne.

The Nation's Mourning for Henry V. and the Coming of the Tudors

But the king's son would not consent, nor many of the French nobles, and the war did not end. Now, whether Henry would have conquered all France, making one dominion of France and England, and would then have led great armies to a Holy War against the Turk, as he desired, none can tell; for he died, being yet a young man, having reigned only nine years. And all England mourned for him, and cherished his memory as the pattern of true knighthood, as may be seen by the story of him which Shakespeare told in his plays, nearly two hundred years later.

But when Henry died, no lesser man than he could achieve the conquest of France. And great troubles came upon England, and the strife for the crown called the Wars of the Roses, of which we read on page 756.

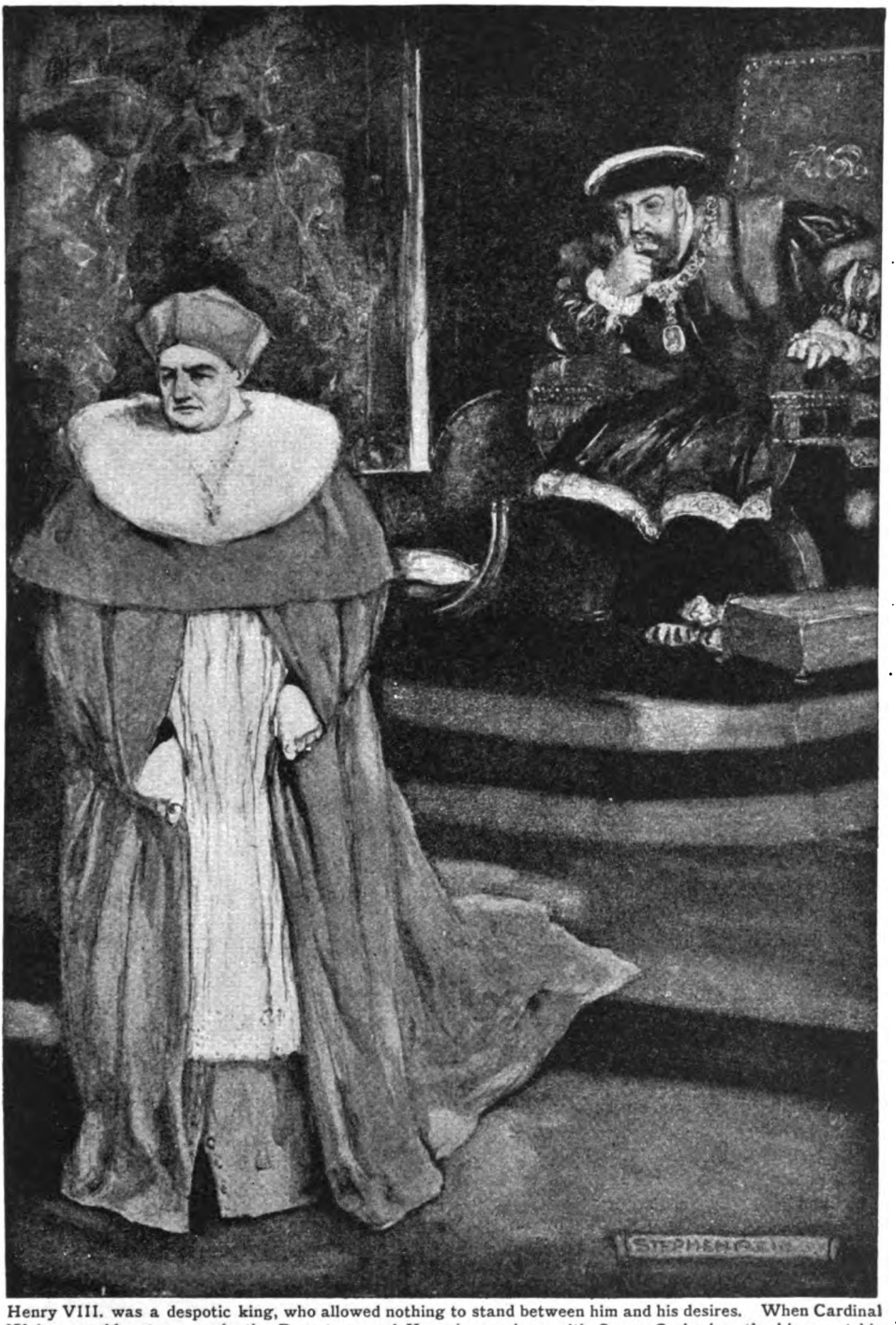
The man who ended these troubles, and once more gave to England order and firm rule, was another Henry, the Seventh, being the first king of the House of Tudor, and of kin to the House of Lancaster, which began with Henry IV. He overthrew the usurper Richard III., who had murdered the king his nephew, and when he had wedded the Princess Elizabeth, who was by right the heiress of the throne of England, the white rose of York and the red rose of Lancaster were united. Nevertheless, for many years there were endless plots against him, and Henry had a hard task enough to put down the power of the nobles, which had so grown that some of them could lead an army of retainers to battle, and make the kingdoms of Europe pay heed to the will of England.

The Magnificence of Henry VIII. and his Friend Cardinal Wolsey

Yet he did these things not by war, but by craft, and he was like the Roman emperor Vespasian in his carefulness of money, and his carelessness whether he gathered it by fair means or foul, so that the treasury was well plenished. In this, too, he was like Vespasian, that he had no wish to shed the blood of his enemies; but, though he spared their lives, he took their goods. And when he died there was none in the land strong enough to oppose his son Henry; and the townsfolk and the merchants were prosperous; and the kings of France and Spain and the German Emperor were all eager for the friendship of England.

Now, in the first years of his reign, Henry VIII. was a very splendid young king, skilled in all sports, yet skilled also in letters, and loving all magnificence. Men saw that he was ambitious and wished to be a famous king; yet he seemed to leave all statecraft to his minister, Cardinal Wolsey, and to care more to make a mighty display when he met the King of France at the famous "Field of the Cloth of Gold," shown on page 840, than about the political plans of the cardinal. Yet the

HENRY VIII. DISMISSING CARDINAL WOLSEY



Henry VIII. was a despotic king, who allowed nothing to stand between him and his desires. When Cardinal Wolsey could not persuade the Pope to cancel Henry's marriage with Queen Catherine, the king cast his minister from power, as we read on page 2380. When Wolsey knew that he had lost the king's favour, he staked everything on a final interview. Henry acted at first as though he were going to receive **Wolsey back into favour, but at last the cardinal was dismissed coldly, and never saw the king again.**

cardinal himself knew very well that he must satisfy his master that his plans were wise, and that if he crossed the king's will he would be cast off.

And so it befell. For the king was minded to take a new wife in place of his queen, Catherine of Arragon, giving for his reason that his marriage with her was not lawful, seeing she had first been the wife of his brother Arthur, who died young, although the Pope had granted what was called a dispensation, giving leave for the marriage. Now, however, there was another Pope, and Henry would have him say that the old Pope had done wrong. But the new Pope listened to the Emperor Charles V., who was nephew of Queen Catherine, and would not do as the king desired. And because Wolsey could not persuade the Pope, Henry cast him from power, so that he died not long afterwards, repenting, as he said, that in his faithful service to the king he had forgotten to serve the King of kings.

How Henry cared for nothing more than for his own pleasure

Now, Henry was very wroth with the Pope. And in those days Martin Luther had risen up with his new teaching that the Pope was an ordinary man, and not the oracle of God, and that men should seek God not through priests, but through the Bible only. Henry held Luther's new doctrines to be for the most part false; but, as the Pope would not give him his will, he was ready enough to say that England had no need of the Pope, and that the laws of the Church should no longer prevail in England unless they agreed with the king's law.

So Henry defied the Pope, and permitted no more money to be paid to him as had been done for centuries; and he put away his wife Catherine, and took the new wife whom he desired, Anne Boleyn, who became the mother of Queen Elizabeth. Nor was Henry content to break away from Rome; for he dealt very hardly with the churchmen in England, saying that they taught men to obey the laws of the Church and the Pope rather than the king's laws, and that they did many other evil deeds. Therefore he took away their lands, and overthrew the religious houses. And this also is remembered of Henry, that he married six wives, of whom he put away two and cut off the heads of two more; and one died soon after the birth of a son, who became King Edward VI. But the last wife kept the king's good graces until he died. And this is true of Henry, that he suffered nothing to stand between him and his pleasure, sparing neither foe nor faithful servant; but though his ways were those of a tyrant, yet many men believe that he was wise to bring about the separation of the Church of England.

A Dutchman who ruled England when the people drove out the Stuarts

Now, we shall not here speak of the kings who came after Henry for a hundred and forty years; for of those kings there was none who helped to make England greater. But the next king of whom we have to tell was not an Englishman at all, though his mother and his wife were both of them English princesses, but a Dutchman, William of Orange. He was made King of England because the people were weary of the Stuart king, James II., who sought to rule the country after his own will, and to restore the Roman Catholic religion, and was for this compelled to give up his throne and leave the country. But the daughter of James, who was William's wife, was a Protestant, and he was the head of the Protestant state of Holland, against which the Catholic king, Louis XIV. of France, the cousin and friend of King James, was making war. So the English asked William to be their king in place of James, if he would promise to pay heed to the liberties of the people and the rights of Parliament. And William, though a foreigner, proved himself a wise and just man, not forcing his own will upon the nation, but guiding it shrewdly; not seeking to bring destruction upon his own enemies, though they sought his life.

How a mole-hill robbed a kingdom of its king

And England owed it to him, first, that she was not rent in twain by civil strife; and, second, that the might of the French king was held in check. For Louis wished to bring back King James to the throne; and, indeed, would have made England serve his will as he had done in the days of Charles II. King William died from the injury he

WILLIAM THE THIRD & GEORGE THE THIRD

James II. became so unpopular that William Prince of Orange was invited by the English to become their king as William III. He sailed for England with a large fleet, and landed at Torbay, in Devon, as shown here, on November, 1688, the anniversary of gunpowder treason and plot. At first people were afraid to join his standard, but James II. was deserted and William marched triumphantly to London, where he was greeted as king.

George III. reigned for sixty years, longer than any other king of England, and in the early part of his reign he did much harm by his obstinacy and his wrong ideas of how a king should rule. But he was an honest man, and showed courage and resolution in the dangers that beset his kingdom. Here we see him with his sons in Hyde Park, reviewing the Honourable Artillery Company, one of our oldest Volunteer regiments.

Edward the Confessor

William Rufus

Henry I.

Henry II.

Edward III.

received by a fall from his horse, which stumbled over a mole-hill.

After this time it was not so much the kings of England who ruled her as the leaders in Parliament, the kings showing their wisdom chiefly by their readiness to act as wise ministers advised; for they could still make it easy or difficult for a minister to carry out what he thought best. After Queen Anne, who followed William, the British people set King George I. on the throne, though he was a foreigner, because they were determined to have a Protestant king.

As he would have been very quickly turned off the throne again if he had not allowed the ministers to follow their will, his influence was small; but in the reign of his son, George II., England became very powerful, because the king was shrewd enough to see that first Sir Robert Walpole, and afterwards William Pitt, gave better counsel than his own. So that Walpole kept the country at peace, whereby her wealth grew greatly, and afterwards, when she had to fight France for the rule in America and in India and on the seas, Pitt guided her so well that in that war she triumphed everywhere.

But as for George III., the grandson of George II., he was king for sixty years; and for the first twenty years he did nothing but harm. But a time came when the British nation once more found itself fighting for life and liberty against France, when the people were filled with fear that their country was going to be invaded by the man who had made all Europe bow to his will, and had left death and ruin everywhere behind him; and in this one thing King George served her well, that through many dangers he never lost courage, but was resolute, not only to fight for England, but also to aid those peoples in Europe who had risen up to resist the dominion of the mighty Emperor of the French, Napoleon Bonaparte.

And so, though "Farmer George," as men called him, did many things that were not wise, yet, because he was an honest and good man, who wished to do what he believed to be right at all costs, and because in the hour of England's peril he never faltered, his name is remembered among the kings under whom Great Britain grew to greatness.

The next Men and Women begin on page 2779.

Henry VI.

Henry VII.

James I.

George I.

George II.

LITTLE GIRLS OF LONG AGO

We have been rummaging through the garret and have perhaps come across an old horsehair trunk hidden in an out of the way corner under rafters, thick with dust and tangled in a meshwork of cobwebs.

We have not been looking for the trunk, but being girls and full of wholesome curiosity, we settle ourselves on the floor before it with little "ohs" of delight.

"It must be great-grandmother's trunk," we exclaim, as we push the wobbly cover and begin to poke eagerly in its dusty depths.

Yes, truly, it is great-grandmother's trunk. And such a wealth of dear old-fashioned things we find in our treasure-trove. A chintz-covered bandbox with a quaint lavender poke bonnet; a yellow piece of canvas with the motto, "Jane Adams, her sampler;" a bundle of letters tied with pink ribbon; a queer old spelling book; a pair of tiny high-heeled slippers, and last of all a short-waisted, short-sleeved muslin gown, sprigged with tiny faded lavender blossoms, with bits of dried lavender still clinging in the folds.

With exclamations of wonder and delight and a good deal of hushed laughter, we all try on the lavender bonnet, and vainly try to get our feet into the diminutive slippers.

"Let's go and ask grandmother to tell us all about the dear funny things!" exclaims Sarah. So gathering our spoil into our arms, we troop down the stairs to gather about grandmother's chair and hear her tell of the days long, long ago when great-grandmother was a little girl.

How interesting it all was; how demure and staid little girls were expected to be, and how different they were in different parts of our big new country.

THE PURITAN MAIDEN

In New England, little maids were brought up very strictly. Vanity and worldliness were greatly dreaded among the Puritans, so the girls dressed in gray homespun frocks with a white kerchief folded demurely at their throats and a little gray cap with a white border, to cover away from sight that chief of all vanities, a woman's hair. While they were little, the Puritan maidens wore their hair in two smooth braids coming from under the cap and hanging down their backs; but when young womanhood was reached the glossy braids were coiled away out of sight.

The education of the Puritan girl in book learning was sadly neglected. Though her brothers trooped off to school every morning, she usually remained at home, and received what instruction she got from her mother. A little reading and writing was all that was deemed necessary for a girl to know, and in the latter she often could do little more than inscribe her name.

WHAT THE LITTLE NEW ENGLAND GIRL KNEW

But if the little girl of New England was deficient in book learning, the same could not be said of her knowledge of housewifely arts. A more accomplished little housewife could hardly be found. She spun, and wove and baked and brewed, and washed and knitted.

Almost all the clothes and household linen were spun and woven by the women, and the little girls did their share of the work. They were taught to spin on the "great wool wheel" when they were so small that they had to stand on a foot-stool to reach it. They skeined the yarn on the clock reel, and easily filled the "quills" with woollen

yarn used in weaving bedspreads. Girls of six could very often spin flax.

VARIOUS LETTERS AND FIGURES EMBROIDERED ON A SAMPLER

Every little Puritan girl was exceedingly deft with her fingers. Each one made for herself a sampler, worked in truly marvellous stitches. Some of the samplers that have come down to us that were embroidered by little girls of long ago show such exquisitely fine stitching that we are forced to hold up our hands in wonder that such perfect needlework was done by such little hands. But skill in dainty needlework never came without days and years of weary toil, and many were the tears our poor little great-grandmothers shed, as they sat in their high-backed chairs and forced stiff little fingers to pick those difficult stitches.

But spinning and sewing were not the only tasks of the Puritan maiden. She dipped candles in the spring and made soap in the autumn. She knit stockings and mittens for the sharp days of winter and she made gorgeous quilts, warm and enduring enough to defy the cold days of many successive years.

The Puritan maid was a wonderful cook. The week before Thanksgiving saw her busily helping her mother in the kitchen, stoning raisins, mixing batters, cutting up pumpkins and stuffing turkeys. Her mother never said "Leave that alone, child, you will make a mess of that pudding." The little girl was expected to know how to bake pies and make mince meat with the best of them.

WHAT GIRLS MUST NOT DO

Was it any wonder that our little great-grandmothers grew up into capable wives and mothers? Every pain was taken to train them up in the way they should go, and due respect to elders was one of the things insisted upon with greatest rigidity. The maiden of sixteen was told that she "must not prate unduly in the presence of her elders." A book on manners for little maids holds this good counsel:

"When any speak to thee, stand. Say not I have not heard it before. Never endeavour to help thine elder out if he tell it not right. Snigger not; never question the truth of it."

And so the little maid grew to young womanhood, demure-eyed and sober-mannered, yet self-reliant withal, versed in housewifery, and well fitted to become a help to the earnest-eyed Puritan lad who was building up a home for himself in this new, wild land where he might worship God according to his conscience.

A LITTLE GIRL IN OLD ALBANY

In very different surroundings from the Puritan maiden, the little Dutch girl of old Albany lived. She was taught to be just as respectful to her parents as the little girl of New England. But unlike the Puritan maiden, she was bustled off to school with her brothers, her many petticoats sticking out about her, her wooden shoes going clop-clop, and her two flaxen braids blowing out behind from under her white cap, as she hurried along for fear that she might be late to the dominie school. But though the small Dutch kinderchen went to school she fared little better in learning than her New England sister. A smattering of reading, writing and ciphering was taught in the school, but the great trouble lay in the fact that the dominie was usually English, and a mixture of bad English and Dutch was spoken, with the result that very little if anything in the way of knowledge was gained. When Katrine was ten or eleven she was removed from school and became the assistant of her mother, the sturdy huys-vrouw, in the housework.

BREAKFAST IN ALBANY LONG AGO

At the break of every day she was awakened by the loud blasts of a cow horn and the jangle-jangle of scores of loud-tongued brass and iron bells as the cows gathered from different parts of the town to follow the town herder to pasture. Scarcely had the cows departed before the sturdy little Dutch maiden was making a crackling fire on the hearth of the great brick chimney. Soon the room was full of the appetising odours of breakfast as she and her mother bustled to and fro, preparing the morning meal for Mynheer, the

father. Buttermilk or home-brewed beer washed down a breakfast of Dutch cheese and sausage. When the children had been bustled off to school and Mynheer, after smoking his long pipe of tobacco, had departed stolidly about his day's business, then began a round of domestic drudgery for the good vrouw and round-eyed, rosy-cheeked Katrine.

The flock of snowy geese, the pride of the Dutch housewife, are fed and disappear clacking and waddling down the town streets to seek the waterside. Next the cream is skimmed from the milk crocks and then comes the process of churning butter and making the delicious cheeses for which the Dutch settlers are famed.

KNITTING SCARLET STOCKINGS

In the afternoon, the little Dutch maiden settles down to her spinning and weaving while her mother knits. Presently she, too, takes up her knitting and strolls through the stiff little garden to visit one of the next door neighbour's daughters. While Katrine gossips her busy shining needles keep up their incessant click-click, for the wool must be made into the scarlet-clocked stockings, a goodly supply of which is the pride of every huys-vrouw.

The Puritan maiden, as we have told you somewhere else in our book, was forbidden the celebration of Christmas; not so Katrine and her group of girl friends. Christmas Day in New Netherlands was welcomed with shouts of welcome and songs of St. Nicholas, and it brought well-filled stockings and warm, mulled cider and feasts of all the good things Katrine and her mother could make.

THE LITTLE QUAKERESS

The little Quaker girl of Pennsylvania was brought up with all strictness of the Puritan maiden, and perhaps with even more regard to the forswearing of the vanities of this wicked world. Clad in her plain, drab-coloured gown, and her stiff unadorned poke bonnet she made her way each morning to the school, walking soberly and with downcast eyes, for noise and frivolity were strictly forbidden, and little girls must behave sedately, though rebellious little feet longed to run and dance in the fields and small hands itched to throw books aside and pick the "carnal weeds" that made the wayside glorious.

A QUAKER SCHOOL LONG AGO

The education of the little Quaker girl was perhaps a little better than that of her New England and New Amsterdam for even in the early days of the colony, great care was taken to secure competent teachers for the children that "all wicked and scandalous living may be prevented and that youth may be trained up in virtue, and useful arts and knowledge." As early as 1683 an educational institution was established for the children of the colonists. In that year "the Government & Provll Council having taken into their serious consideration the great necessity there is of a school master for the instruction and Solar Education of youth in the towne of Philadelphia," sent for Enoch Flower "to whom having communicated their minds, he embraced it upon these following terms: To learn to read English 4 shillings by the quarter, to learn to read & write 6 shillings by ye quarter, to read, write and cast accts., 8 shillings by ye quarter," ". . . . for boarding a Scholler, that is to say, dyet, washing, lodging and schooling Tenn pounds for one whole year." And so to master Enoch Flower our little maiden soberly trotted off each morning to learn to "read, write, and cast accts. at 8 shillings by ye quarter." At home under the severe eye of her mother she learned to sweep, and cook and spin.

HOW OUR LITTLE QUAKERESS WAS PUNISHED

Among the Quakers the obedience of children to their parent was always emphasised. Modesty and bashfulness were considered the ornaments of youth, and if our little maiden even strayed from the ways of righteousness into a worldly burst of animal spirits that led to dancing and singing she was "dealt" with by her parents, and the small culprit was made to sit up straight in a

stiff-backed chair while she read aloud for an hour from "No Cross, No Crown," or Barclay's "Apology," or perhaps, if the offence had been a particularly naughty one from "The Sinner Awaking," and so the little woman was taught to walk in the narrow path, and if the way were salted with tears and a rebellious little heart longed for gay ribbons and pretty dresses, yet it did not prevent the slim maiden in her severe gray frock, with her gentle "thees," from growing very sweet and womanly.

MY LITTLE LADY OF THE OLD PLANTATION

The life of the little girl of the South differed as widely from the little Dutch kinderchen as it did from that of her New England cousin. Possibly she was born on a large plantation where she was from the first moment the "daughter of the house." While still a child in her short-waisted muslin frock and quaint sunbonnet she would meet visitors at the front steps of the house porch and entertain them until her gracious, gentle mother was ready to appear. Thus our little Southern girl grew up to the duties of a hostess, with manners as sweet and unconscious as those of any lady of the Old World. She was devoted to her family, and her father was like a king upon his large plantation. She was a delicate slip of a girl, as dainty and sweet as a flower. Accustomed to the devoted care of her negro "mammy" and ever surrounded by a troop of darkey servants to do her bidding, she was often unused to putting on her small slippers or combing her soft hair.

LEARNING HOUSEKEEPING AND OTHER THINGS

Yet, like the little Dutch and Puritan maidens, my little lady of the South was an excellent housewife. True, there was very little that she could do with her own hands save fine needlework, yet she could superintend the household activities of the darkey servants with wonderful capability. Her early education was secured with her brothers under the house tutor, from whom she learned reading and writing and arithmetic and sometimes Latin and French. Dancing and playing upon a quaint old instrument called the spinet, were among her accomplishments.

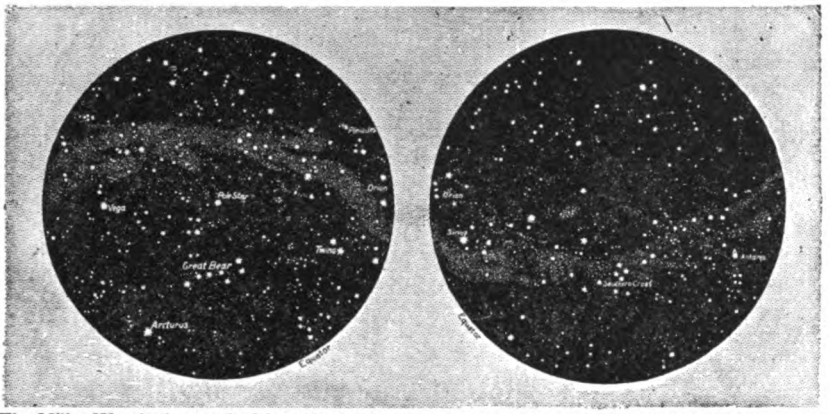
WHAT THE MISTRESS OF A PLANTATION MUST KNOW

From the schoolroom she passed into the hands of her mother, the dignified, gracious mistress of the plantation, from whom she learned what it meant to be the head of a large household. She was taught to measure out the supplies from the big storeroom; she superintended the making of the delicious preserves that lined its closet shelves; she learned where the linen was stored away and how to direct the darkey girls in their spinning. Above all she learned how much responsibility would some day devolve upon her as the beloved mistress of a small household of slaves. The welfare, the health and the happiness of a number of dependent human beings lay absolutely in her slim, white hands. She must learn to be doctor, nurse, manager, and counsellor in time of trouble. "From superintending the setting of turkeys to fighting a pestilence, there was nothing which was not her work."

As the Southern maiden grew older another care was added to her duties. The vegetable garden and the great wonderful flower garden were placed in her charge. Under her mother's guidance she learned the herbs that were used as simple household remedies in case of sickness, and how to distil them.

THE COLONIAL GARDEN AND ITS MISTRESS

Such a garden as it was with its stiff box hedge and its quaint old-fashioned blooms. Yellow cowslips brought over from England, sweet peas, jonquils and hollyhocks — all flowers fragrant with the memory of old English homes — honeysuckle and lilacs and roses all ran riot together. With her sunbonnet over her dainty head and a small black boy following at her heels with basket on his arm and a pair of shears, the daughter of the plantation would sally forth each summer morning into her wonderful old-fashioned garden with its quaint box hedge. There among her roses and her lilies, as fair and sweet as the flowers she gathered, we shall leave the little Southern girl.



The Milky Way is the wonderful continuous band of stars tha tencircles the heavens. The left-hand picture shows it in the northern heavens, and the right-hand picture shows it in the southern heavens.

THE COLOUR OF THE STARS

CONTINUED FROM 2617

By means of three instruments we are able to study the stars, and learn a great deal about them. These instruments are the eye, the telescope, and the camera. The telescope helps the eye by increasing its acuteness and by adding preciseness to what it observes; and the camera helps because it is sensitive to certain light of the stars which the eye would not see, even aided by the best telescope that exists. All that these instruments can do, however well they may be employed, and however perfectly developed, is simply to show certain points of light in the sky, so that, as we read on page 2616, we may compare their appearance as seen from different parts of the earth's orbit. There is as yet no hope at all of our being able to see the disc of a star—so far away is even the nearest star that it can be seen only as a point of light. We can, however, learn something more about these points of light by means of the instruments we have named, because we can watch their influence upon each other's movements in some cases, and so can learn something of their size or *mass*.

Now, all this is very necessary and very interesting. We may call it descriptive astronomy—the descriptive study of the stars. But we want to do more than any of these instruments will enable us to do by itself. We are not content merely to map out the heavens, make star catalogues, and calculate the distances of the stars when we can. In every science there is a farther stage. No matter whether you are studying fossils or stars or the weather, there is something more to aim at than mere description, however accurate and however interesting it may be in itself.

What we aim at always, in science, is explanation. Of course we cannot explain unless we correctly know the facts that we are trying to explain, and so description must always come first. Long ago, before men understood the nature of science, they used to try to explain before they went to Nature for the facts, and, of course, their explanations were always wrong and worse than useless. We know now that in every science correct description must come first, but we have to beware of another kind of mistake, which is that of fancying that we have explained a thing when we have correctly described it. The mind always has a tendency to stop and be content in science, until it learns that there is really no stopping-place, and that even a true explanation requires explanation—that is to say, behind

all causes there are further causes still. Now, let us apply this to the study of the stars.

We look at the heavens during the brief moments we call our lives; or, indeed, we may say that mankind looks at the heavens during the little space of the life of mankind; and we desire not merely to see, but to understand. It is not enough to know that such and such things are in such and such places; we want to know how they came into existence, unthinkable ages before the birth of mankind or the making of the earth, and what will become of them after we ourselves are dead, and after the earth itself, perhaps, has passed away. We want to know not merely what is there, but what is happening there. Now, let us very clearly understand that though the eye, the telescope, and the camera have done great things for astronomy, and will yet do more, it is not in their power to answer the questions which the mind is bound to ask.

THE WONDERFUL INSTRUMENTS THAT HELP TO EXTEND MAN'S KNOWLEDGE

Scarcely more than half a century ago it seemed that there must be a limit to the advance of astronomy. No one could even begin to imagine any possible way of making further progress, except in improving what had already been done, making bigger telescopes and better cameras. But as for knowing what the stars were made of, or getting any idea of what was happening in them, there seemed to be no way in which such knowledge could ever be attained; and one of the greatest of thinkers of that time, who died rather more than half a century ago, declared that man could never know the composition of the stars.

Then there came to the aid of astronomy a new instrument, which, like the others, is in itself an instrument of description. But the description is altogether of a new kind, and, unlike the other, it goes a good way towards providing us with the beginnings of real explanation. It tells us something of the history of the stars and something of their destiny, and as yet we have only just begun the study of what has been called the "new astronomy," which directly depends upon the discovery and the use of this instrument. I want particularly to insist on this point, because it has a lesson which is true of every kind of knowledge. All knowledge depends upon methods and instruments. Every method and every instrument has certain possibilities, but it also has certain limits. Then it is not until a new method, or a new instrument, is employed that a new stage begins in the history of that branch of knowledge. Thus the invention of the telescope and of the microscope—which are in themselves only arrangements of pieces of glass—marked great epochs in the history of knowledge.

HOW THE SPECTROSCOPE SHOWS US THE REAL COLOURS THAT ARE IN THE STARS

The same is true of another instrument, which is also only an arrangement of pieces of glass. This is called the spectroscope. Now, *scope* means see, *micro* means little, *tele* means at a distance, *stereo* means solid. What does *spectro* mean?

When white light passes through a piece of glass that is not flat on both sides, it is broken up into the various colours of which it is made. So a ray of sunlight passing through a prism is broken up into a band of colour, which is called a spectrum. Now, a spectroscope is simply an instrument which shows the spectrum of any kind of light that passes into it. A little spectroscope can easily be carried in the waistcoat pocket, and you may hold it up to a flame or to the fire or to the electric light, or to any kind of coloured liquid, and then you see at once a band of colour, which is the spectrum of the particular kind of light you are looking at. This spectrum can be studied, piece by piece, or analysed, as we say, and so the study of spectra is called *spectrum analysis*

THE NEW FIELD OF KNOWLEDGE OPENED UP BY THE SPECTROSCOPE

By this little instrument a whole new world of discovery is opened. No sooner do we put it to the eye, and turn it upon anything from which light proceeds, than we learn that everything which gives out light gives out light of a particular kind, or, as we say, has its own spectrum. Every chemical element, for instance, if made to give out light, is found to give out light which shows a different spectrum from that of any other element. So you can turn the spectroscope on to a gas-flame, for instance, and say at once, by looking at the band which is spread out before the eye, whether there is sodium there, or

carbon, or hydrogen, or potassium, or radium, as the case may be. Now; if you can do this to a gas-flame, you can do it to the sun or to a star, and this means that the key to the composition of the stars is in our hands. If you take a pinch of salt and let some of it drop into the flame of a lamp or the gas, a brilliant yellow colour will at once appear. It is so unmistakable that the eye alone can recognise it. But if you are looking at the flame through a spectroscope, you will instantly see the spectrum of sodium appear, and so you know for certain that there is glowing sodium in that flame.

How we can tell what the stars are made of from their colours

Now, this is very interesting indeed, and it means that sodium can be detected by the spectroscope in exceedingly tiny quantities when the unassisted eye would tell us nothing. By exactly the same process, turning the telescope to the sun, or to a star or a comet, and applying the spectroscope, it is possible to say "There is sodium there." To-day a great part of all astronomical study is concerned with the spectrum analysis of the sun, the planets, and the stars, and the results are simply tremendous. Here, of course, we can only learn the principal things which they teach us.

First, we learn from spectrum analysis something which no one could well have expected. We readily understand how the telescope and the camera can teach us something of the movements of the stars; but, if we come to think, we shall see that the only kind of movement which they can show for us is a movement *across* the sky. But suppose that a star be moving *through* the sky in our line of vision, whether from us or towards us, and no matter at what speed, then the telescope will tell us nothing.

The movement of the stars through the vastness of space

No doubt in the course of long years it would record a difference in the brightness of the star, but we should have no way of knowing whether this was due to something happening in the star or to its movement. Now, the spectroscope has actually provided us with a means of discovering the movement, and even the rate of movement, of stars which are moving in our line of sight.

The results thus obtained, added to our knowledge of star movements obtained by the telescope, are beginning to give us the outlines of what is happening in the world of stars, so far as movement is concerned. But first we must notice the beautiful way in which the spectroscope helps us here.

If we are standing at a railway station, and listen to the sound of a moving train, we notice that the engine's whistle rises in pitch if the train is approaching us, and falls if the train is going away. The pitch of the note depends on the number of waves that reach our ears every second. If the train is approaching us, of course it crowds these waves upon one another, so that more of them reach our ear in a given time, and the pitch of the note rises. If the train is going away, of course the intervals between the waves are dragged out a little, and so the pitch of the note falls. The discovery of this principle was first made as regards sound, but it is true of light also. Instead of the railway train and the engine's whistle sending out waves of sound, let us think of a star sending out waves of light. Now, if the star is moving in our line of vision, the waves will be crowded upon each other, or dragged out, according to whether the star is moving towards us, or from us.

Do the stars move in straight lines or along a curved path?

By spectrum analysis we can detect the consequent changes in the star's light, and so can accomplish the feat which it was declared could never be accomplished by man—that of discovering the motion of the stars in our line of vision.

Thus, by means of the telescope and the spectroscope, we are now beginning to learn a great deal about the movement of the stars which used to be called fixed, and everyone must wish to know whether any general truths can be discovered about the movements of the stars. For instance, is there a centre of the universe, perhaps occupied by a mighty star, around which all the other stars are revolving, like planets round a sun? This has often been supposed. We have no evidence of it, however, but we have evidence, rather, of something quite different. Then, again, we know in the case of the earth, and the other planets and the comets, that the motions of heavenly bodies

are in circular or elliptical paths, not onwards in straight lines for ever. It is natural to ask, therefore, whether the stars move in similar paths, or whether they dash on in straight lines. So far as the evidence goes at present, we cannot detect a curved path to any star; but it must be remembered that our knowledge of star motions is very young, and that if stars moved in curves, those curves would doubtless be very enormous, so that it might perhaps need centuries of observation to show that a star's path was really curved, and not a straight line.

Another question that has to be asked is about the motion of the Milky Way. This, we know, is a mighty belt of stars, somewhere in the middle of which our sun is placed. To the eye, of course, the belt looks equally distant at any part, and, though we cannot be quite sure yet, the Milky Way is probably not far from being a circle. We know something of the proper motions, as they are called, of many of the stars in the Milky Way; but what we should like to know is whether this mighty belt, as a whole, is spinning. No one can yet say.

ARE THERE TWO GREAT WORLDS OF STARS RUSHING THROUGH EACH OTHER?

For some years past, however, a famous German astronomer has devoted himself to the study of the movements of the stars, and now he has been followed by an English astronomer working at Greenwich, and these students are beginning to show that, in all probability, the movements of the stars reveal to us something which was never suspected before.

In the first place, the movements of the stars are not entirely helter-skelter, even allowing for the movement of the sun and of our earth with him, which is, of course, sufficient in itself to give us the impression that the stars are drifting in a particular direction. Even fully allowing for this, yet it is plain that there are definite tendencies in the star movements, and we learn that these movements form, as a whole, two great drifts, which are moving in opposite directions to each other. One drift is moving considerably faster than the other, but both are moving. To one of these drifts, it seems, our sun belongs. It looks, then, as if there were two sets, or systems, of stars in the heavens.

This is a startling idea—that the stars which we see in the heavens really belong to two systems, which may even at one time have been far apart from each other in space, but which have met, and are now rushing through and past each other. How many more such systems there may be in infinite space, no one knows.

WHAT WE ARE LEARNING FROM THE STUDY OF THE CHEMISTRY OF THE STARS

Of course, it need hardly be said that astronomers all over the world are keenly studying this theory of Professor Kapteyn's, and what we now know of the movements of the stars will appear scarcely more than a few scattered trifles of knowledge in twenty or thirty years. But, at least, we are for ever past the old idea which was expressed in the phrase "fixed stars."

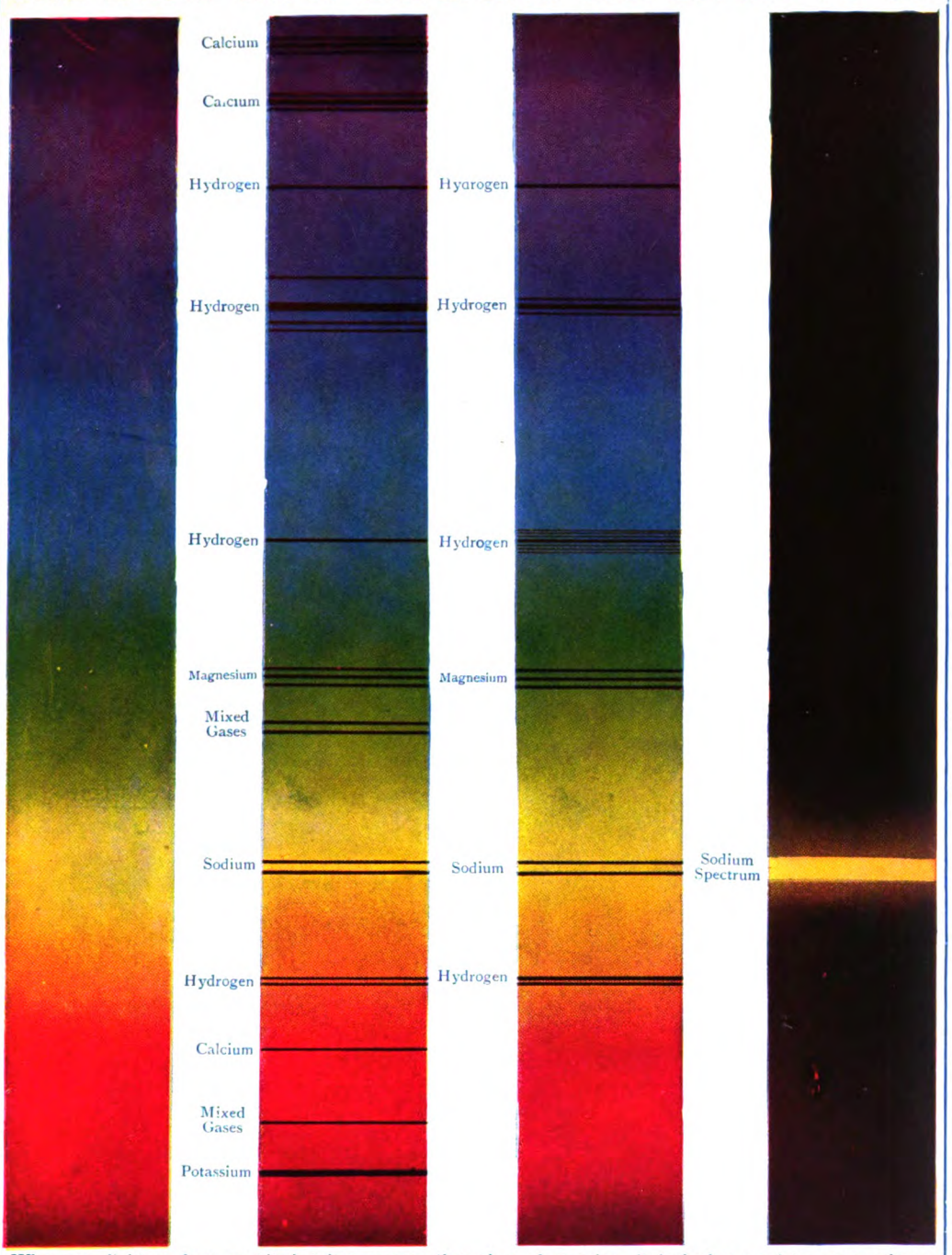
The contributions of the spectroscope to our knowledge of star motions have been very valuable, and no other means that we can imagine could have done for us what it has done. Yet they are quite the least part of what the spectroscope has taught us, for, as we have already hinted, it has created an entirely new field of knowledge—the chemistry of the stars. The study of star chemistry, like that of star motions, is still in its infancy, and in the main it is still a matter of description, but we are beginning to be able to explain also what we describe.

The first great result of the study of star chemistry is that everywhere throughout space, so far as we can see, the heavenly bodies are made of the same elements as those we find upon the surface of the earth.

THE STARS ARE MADE OF THE SAME ELEMENTS AS THE EYE THAT SEES THEM

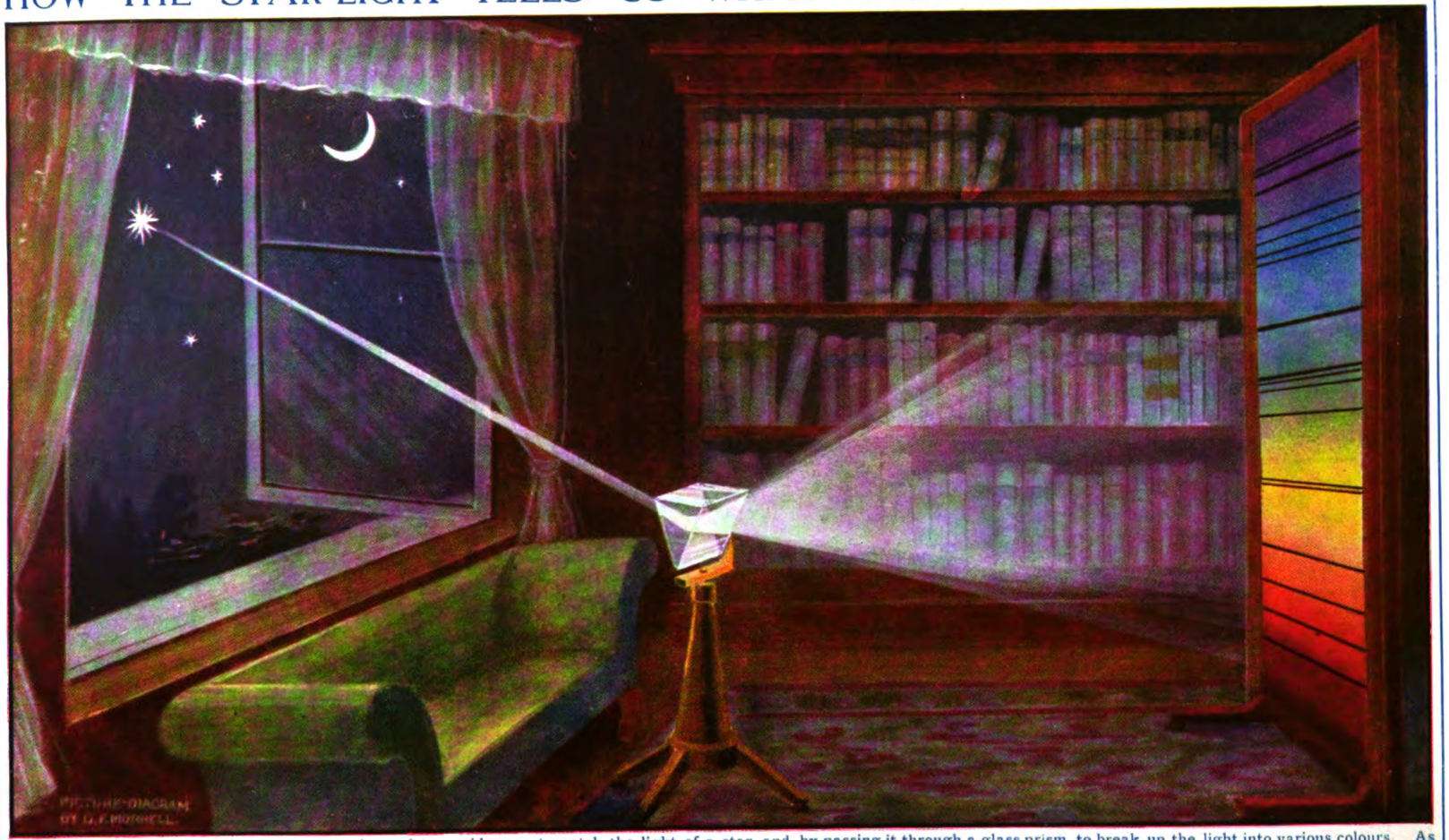
The features that we find in the spectrum of sodium or oxygen, when these are made to glow, we find in the spectrum of the sun or of many stars, and no one will question our right to conclude that the same effects are produced by the same causes, and that, therefore, sodium, oxygen, carbon, and so forth, are to be found in the stars. Not only so, but, with scarcely an exception, we find in the spectrum of the stars no features that we cannot refer to elements which we already know. The meaning of all this, not only for science in the narrow sense of the word, but for

THE LIGHT THAT EXPLAINS THE STARS TO US



When pure light, as from a white-hot iron, passes through a glass prism, it is broken up into seven colours, called the spectrum, as shown in the first picture. But light from the sun shows, in addition to the colours, various lines, as seen in the second picture. These lines are caused by some of the different substances that compose the sun. Although here we see only a few lines, the sun's spectrum really shows over 2,000 lines. The third picture is the spectrum of a star, Sirius, and when compared with that of the sun, it tells us that the stars are made of the same materials as the sun and earth, because the lines in the spectrum for different substances always appear in the same position in relation to each other, as can be seen by comparing these spectra of the sun and Sirius. Although the spectrum colour of the metal sodium is yellow, as in the fourth picture, this appears dark in the sun and star spectra, because of the intense light behind it, just as a gas-jet seen in front of the sun's disc appears black; but of course sodium is in the same position in all the spectra.

HOW THE STAR-LIGHT TELLS US WHAT THE STARS ARE MADE OF



This picture shows us how the spectroscope is used to enable men to catch the light of a star, and, by passing it through a glass prism to break up the light into various colours. As different metals give off different colours, we can in this way tell what the stars are made of. This picture does not show the whole spectroscope, but illustrates the principle.

knowledge itself, is stupendous. The very elements that make up the eye of the astronomer, or of the child who reads these words, can be practically seen glowing in the surface of a star so remote that perhaps it is thousands of years since the light by which we study it left the star. Throughout these enormous distances of space, in every direction we gaze, and in every variety of star, we find clear proof of the existence of the very same kinds of atoms as those we are breathing now, of which earth, air, and sea are made. Thus, if we never before had the right to use the word universe, we surely have it now, when the spectroscope teaches us that the very elements of which our own bodies are made are glowing in the farthest star, or were glowing when the light from that star left it.

No other revelation of the spectroscope could be more tremendous or have more meaning than this has; but by its aid we have already learnt much more. We do not find that the spectrum of one star is the same as that of another. On the contrary, we find that the stars can be classified according to their spectra, and this classification helps us to proceed from description to explanation, because it tells us something of star history.

THE THREE KINDS OF STARS THAT TEACH US SOMETHING OF STAR HISTORY

It seems that we may roughly divide the stars into three groups, according to their spectra, and no one will doubt that this way of classing them is much more important than classing them by brightness, as we usually do. In the first class, which is the hottest, we find proof of the existence of large quantities of hydrogen and other gases. These have been called the *gaseous stars*. The second group of stars is less hot, and these have been called the *metallic stars*, because they yield evidence of the existence of metals, such as calcium, magnesium, copper, iron, and many others. The third group of stars is cooler still, and these are sometimes called the *carbon stars*, because carbon is so conspicuous in them.

Now, we have already learnt enough to teach us that these results mean something regarding the history of the stars. Long ago it would have been supposed that the different kinds of stars were made as they are, and have always been as they are, just as it was supposed that the elements, and the different kinds of living creatures on the earth, were made in the beginning as they are now. Nowadays, however, we have come to understand the great idea of evolution, which teaches us that things develop or evolve from one another.

CHANGES IN STARS THAT TAKE LONGER THAN THE LIFE OF MANKIND

It is much more than probable that the different kinds of stars which we can recognise illustrate for us different stages in the history of any star—stages which take such a tremendous time that no doubt the whole past life of mankind would not be sufficient time in which to notice any change in any one star. We believe that the hottest stars are the youngest, and that gradually, as a star cools, its chemical composition changes and the metals appear. Then carbon becomes the most conspicuous element.

Then, as we believe, the star cools still farther, until it loses its light. After that stage we can no longer study it by the spectroscope, for there is nothing for the spectroscope to examine. We can no longer see it at all; we can only learn something about it either because it eclipses a bright star, or because by gravitation it affects the movements of a bright star. It seems likely that the bright stage of a star is much the shortest, and that, after a brilliant youth, the star settles down to a long period of darkness.

Of course, we must ask where the hot, white hydrogen stars come from. If our account of stars is to be at all satisfactory, we should be able to trace out a way by which the dark, cold star may become a hot one again.

DO THE STARS DIE OUT AND BECOME STARS AGAIN?

It is not as if the skies gave evidence that things are running down and coming to an end. On the contrary, the skies contain stars in every stage of a star's history, and there is no more evidence, on the whole, of ending than there is of beginning. Somehow or other, dark stars must be capable of starting again, and the question is how. We shall find the key to the answer when we study the nebulæ. We may learn, perhaps, that though they are not stars now, they were stars once, and will be stars again.

The next part of this is on page 2861.

THE FROLIC OF JOHNNY THE STOUT

"Ho! for a frolic!"
Said Johnny the stout;
"There's coasting and sledding—
I'm going out!"

Scarcely had Johnny
Plunged in the snow,
When there came a complaint
Up from his toe.

"We're cold," said the toe,
"I and the rest;
There are ten of us freezing—
Standing abreast."

Then up spoke an ear:
"My! but it's labour—
Playing in winter. Eh,
Opposite neighbour?"

"Pooh!" said his nose,
Angry and red;
"Who wants to tingle?
Go home to bed!"

Eight little fingers,
Four to a thumb,
All cried together—
"Johnny, we're numb!"

But Johnny the stout
Wouldn't listen a minute;
Never a snow-bank
But Johnny was in it.

Tumbling and jumping,
Shouting with glee,
Wading the snow-drifts
Up to his knee.

Soon he forgot them,
Fingers and toes—
Never once heeded
The ear and the nose.

Ah, what a frolic!
All in a glow,
Johnny grew warmer
Out in the snow.

Often his breathing
Came with a joke:
"Blaze away, Johnny!
I'll do the smoke."

"And I'll do the fire,"
Said Johnny the bold;
"Fun is the fuel
For driving off cold."

THE BALLAD OF AGINCOURT

ON page 1856 we read that charming fairy poem "The Arming of Pigwiggen," by Michael Drayton, one of the famous Elizabethan poets. Here we have one of his finest and most spirited ballads, in which, with quick and graphic touch, he describes the great battle of Agincourt, where the English army, led by King Henry V., won a great victory over the French after a closely contested battle, in which some 10,000 soldiers were killed. We read about the battle in the Book of All Countries on page 754.

CONTINUED FROM 2648.

FAIR stood the wind for
France,
When we our sails advance,
Nor now to prove our chance
Longer will tarry;
But putting to the main,
At Caux, the mouth of Seine,
With all his martial train,
Landed King Harry.

And taking many a fort,
Furnished in warlike sort,
Marched tow'rds Agincourt
In happy hour;
Skirmishing day by day
With those that stopped his way
Where the French gen'ral lay
With all his power.

Which in his height of pride,
King Henry to deride,
His ransom to provide
To the king sending;
Which he neglects the while,
As from a nation vile,
Yet, with an angry smile,
Their fall portending.

And turning to his men,
Quoth our brave Henry then:
"Though they to one be ten,
Be not amazèd;
Yet have we well begun,
Battles so bravely won
Have ever to the sun
By fame been raisèd.

"And for myself," quoth he,
"This my full rest shall be:
England ne'er mourn for me,
Nor more esteem me:
Victor I will remain,
Or on this earth lie slain;
Never shall she sustain
Loss to redeem me.

"Poitiers and Cressy tell,
When most their pride did swell,
Under our swords they fell:
No less our skill is
Than when our grandsire great,
Claiming the regal seat,
By many a warlike feat
Lopped the French lilies."

The Duke of York so dread
The eager vaward led;
With the main Henry sped
Amongst his henchmen.
Excester had the rear,
A braver man not there:
O Lord, how hot they were
On the false Frenchmen!

They now to fight are gone;
Armour on armour shone;
Drum now to drum did groan,
To hear was wonder;
That with the cries they make
The very earth did shake;
Trumpet to trumpet spake,
Thunder to thunder.

Well it thine age became,
O noble Erpingham,
Which did the signal aim
To our hid forces!
When, from a meadow by,
Like a storm suddenly,
The English archery
Struck the French horses.

KING HENRY V.

With Spanish yew so strong,
Arrows a cloth-yard long,
That like to serpents stung,
Piercing the weather;
None from his fellow starts,
But playing manly parts,
And like true English hearts,
Stuck close together.

This while our noble king,
His broadsword brandishing,
Down the French host did ding,
As to o'erwhelm it;
And many a deep wound rent
His arms with blood besprent,
And many a cruel dent,
Bruisèd his helmet.

Warwick in blood did wade;
Oxford the foe invade,
And cruel slaughter made,
Still as they ran up.
Suffolk his axe did ply;
Beaumont and Willoughby
Bare them right doughtily,
Ferrers and Fanhope.

When down their bows they threw,
And forth their bilbows drew,
And on the French they flew,
Not one was tardy:
Arms were from shoulders sent;
Scalps to the teeth were rent;
Down the French peasants went;
Our men were hardy.

Glo'ster, that duke so good,
Next of the royal blood,
For famous England stood,
With his brave brother
Clarence, in steel so bright,
Though but a maiden knight,
Yet in that furious fight
Scarce such another.

Upon Saint Crispin's day
Fought was this noble fray,
Which fame did not delay
To England to carry.
O, when shall Englishmen
With such acts fill a pen,
Or England breed again
Such a King Harry?

TO A NIGHTINGALE: A GREAT POEM BY JOHN KEATS

John Keats was one of the greatest English poets, and no matter how small a selection of the great poems in our language we had to choose, we could not avoid including one or two by Keats, as he wrote at least six which are among the most perfect poems ever written. That given here is one of his masterpieces. It contains a number of allusions to the mythology or fables of ancient Greece, for Keats was steeped in that ancient lore we call "classical," and as a poet he was really more inspired and quickened by the spirit of old Greece than by that of his own time.

My heart aches and a drowsy numbness pains
My sense, as though of hemlock I had drunk,
Or emptied some dull opiate to the drains
One minute past, and Lethe-wards had sunk:
'Tis not through envy of thy happy lot,
But being too happy in thy happiness—
That thou, light-winged Dryad of the trees,
In some melodious plot
Of beechen green, and shadows numberless,
Singest of summer in full-throated ease.

O, for a draught of vintage! that hath been
Cool'd a long age in the deep-delved earth,
Tasting of Flora and the country green,
Dance, and Provençal song, and sunburnt mirth!
O, for a beaker full of the warm South,
Full of the true, the blushful Hippocrene,
With beaded bubbles winking at the brim
And purple-stainèd mouth;
That I might drink and leave the world unseen,
And with thee fade away into the forest dim:

Fade far away, dissolve, and quite forget
What thou among the leaves hast never known,
The weariness, the fever, and the fret
Here, where men sit and hear each other groan;
Where palsy shakes a few, sad, last grey hairs,
Where youth grows pale, and spectre-thin, and dies;
Where but to think is to be full of sorrow
And leaden-eyed despairs,
Where beauty cannot keep her lustrous eyes
Or new Love pine at them beyond to-morrow.

Away! Away! For I will fly to thee,
Not charioted by Bacchus and his pards,
But on the viewless wings of Poesy,
Though the dull brain perplexes and retards.
Already with thee! tender is the night,
And haply the Queen-Moon is on her throne,
Cluster'd around by all her starry Fays;
But here there is no light,
Save what from heaven is with the breezes blown
Through verdurous glooms and winding mossy ways.

I cannot see what flowers are at my feet,
Nor what soft incense hangs upon the boughs,
But in embalmèd darkness, guess each sweet
Wherewith the seasonable month endows
The grass, the thicket, and the fruit-tree wild;
White hawthorn and the pastoral eglantine;
Fast fading violets cover'd up in leaves;
And mid-May's eldest child,
The coming musk-rose, full of dewy wine,
The murmurous haunt of flies on summer eves.

Darkling I listen; and, for many a time
I have been half in love with easeful Death,
Call'd him soft names in many a musèd rhyme,
To take into the air my quiet breath;
Now more than ever seems it rich to die,
To cease upon the midnight with no pain,
While thou art pouring forth thy soul abroad
In such an ecstasy!
Still wouldst thou sing, and I have ears in vain—
To thy high requiem become a sod.

Thou wast not born for death, immortal Bird!
No hungry generations tread thee down;
The voice I hear this passing night was heard
In ancient days by emperor and clown:
Perhaps the self-same song that found a path
Through the sad heart of Ruth, when, sick for home,
She stood in tears amid the alien corn;
The same that oft-times hath
Charm'd magic casements, opening on the foam
Of perilous seas, in faery lands forlorn.

Forlorn! The very word is like a bell
To toll me back from thee to my sole self!
Adieu! the fancy cannot cheat so well
As she is fam'd to do, deceiving elf.
Adieu! adieu! thy plaintive anthem fades
Past the near meadows, over the still stream,
Up the hill-side; and now 'tis buried deep
In the next valley-glades:
Was it a vision, or a waking dream?
Fled is that music: Do I wake or sleep?

TRUE GREATNESS

The writer of this fine poem was Lady Elizabeth Carew, or Carey, who lived in the early years of the seventeenth century, and was the author of a tragedy entitled "Marian, the Fair Queen of Jewry," which was performed in London in the year 1613. She was a relative, on her mother's side, of the great poet Edmund Spenser, and died in the year 1635. The word "seld" in the last verse is, of course, the same as "seldom," but even a poet would now hesitate to use the word, though our language has not changed greatly since the time of Elizabeth, when "modern English" was established.

THE fairest action of our human life
Is scorning to revenge an injury:
For who forgives without a further strife
His adversary's heart to him doth tie:
And 'tis a firmer conquest truly said
To win the heart, than overthrow the head.

If we a worthy enemy do find,
To yield to worth, it must be nobly done:—
But if of baser metal be his mind,
In base revenge there is no honour won.
Who would a worthy courage overthrow?
And who would wrestle with a worthless foe?

We say our hearts are great, and cannot yield;
Because they cannot yield, it proves them poor:
Great hearts are task'd beyond their power but seld:
The weakest lion will the loudest roar.
Truth's school for certain does this same allow,
High-heartedness doth sometimes teach to bow.

*DOBBIN'S FRIEND

In these pleasing rhymes the late Mary Mapes Dodge, several of whose poems we have already read, describes with the charm of simplicity and natural feeling the familiar picture of a kitten as stable companion to a horse. Taken from "Rhymes and Jingles," by permission of Messrs. Scribner's Sons.

DOBBIN has a little friend,
Spotted white and sable;
Every day she goes to him,
In his lonely stable.

Not a mite of dread has she,
Not a thought of danger;
Lightly runs between his hoofs,
Jumps upon his manger;

Lays her soft, warm cheek to his,
Purrs her meek "Good-morning!"
Gives the flies that hover near,
Such a look of warning!

"Dobbin dear," she sometimes says,
"Feel my winter mittens;
Nice and warm, you see, and made
Purposely for kittens.

"Dobbin, dear, such times at home!
Mother has caught a rat!
Brought it home to show to us—
What do you think of that?"

"Dobbin!" she whispers, purring still.
"You often get so weary,
Why don't you balk or run away,
And get your freedom, dearie?"

Then Dobbin gives his head a toss,
And says: "For shame, Miss Kitty,
If I could do so mean a thing,
'Twould be a monstrous pity;

"No, no; my master's good and kind;
I'll never vex him, never!"
And pussy, pleased, still rubs his cheek,
And likes him more than ever.

THINGS THAT NEVER DIE

Miss Sarah Doudney is an English writer well known for her many excellent stories for grown-ups as well as her books for girls. She has also written poetry, and these verses of hers are worthy of inclusion in our BOOK OF POETRY.

THE pure, the bright, the beautiful,
That stirred our hearts in youth,
The impulse to a wordless prayer,
The dreams of love and truth;
The longings after something lost,
The spirit's yearning cry,
The strivings after better hopes—
These things can never die.

The timid hand stretched forth to aid
A brother in his need,
The kindly word in grief's dark hour
That proves a friend indeed;
The plea for mercy gently breathed
When justice threatens high,
The sorrow of a contrite heart—
These things shall never die.

The memory of a clasping hand,
The pressure of a kiss,
And all the trifles, sweet and frail,
That make up love's first bliss;
If with a firm unchanging faith,
And holy trust on high,
Those hands have clasped, those lips have met—
These things shall never die.

The cruel and the bitter word
That wounded as it fell;
The chilling want of sympathy
We feel but never tell;
The hard repulse that grieves the heart
Whose hopes were bounding high
In an unfading record kept—
These things shall never die.

Let nothing pass, for every hand
Must find some work to do;
Lose not a chance to waken love—
Be firm, and just, and true:
So shall a light that cannot fade
Beam on thee from on high,
And angel voices say to thee—
"These things shall never die."

ONLY A BABY SMALL

The author of these familiar and pretty lines, the last four of which are very frequently quoted, was named Matthias Barr.

ONLY a baby small,
Dropped from the skies;
Only a laughing face,
Two sunny eyes.

Only two cherry lips,
One chubby nose;
Only two little hands,
Ten little toes.

Only a golden head,
Curly and soft;
Only a tongue that wags
Loudly and oft.

Only a little brain,
Empty of thought;
Only a little heart,
Troubled with naught.

Only a tender flower
Sent us to rear;
Only a life to love
While we are here.

Only a baby small,
Never at rest;
Small, but how dear to us,
God knoweth best

* From "Rhymes and Jingles," copyright, 1874, 1904, by Charles Scribner's Sons.

WHAT THE STARS HAVE SEEN

Oliver Wendell Holmes was an American physician; born at Cambridge, Massachusetts, August 29, 1809, and died at Boston, October 7, 1894. He achieved world-wide fame as a writer both of prose and verse, and during his long life wrote many books, which are all lighted up with the sun of humour and tender feeling. In these verses he pictures the stars above us as the everlasting silent watchers of what takes place in this world of ours. It is a quaint and humorous fancy, and, of course, is not to be regarded as serious poetry.

WHEN Eve had led her lord away,
And Cain had killed his brother,
The stars and flowers, the poets say,
Agreed with one another

To cheat the cunning tempter's art,
And teach the race its duty,
By keeping on its wicked heart
Their eyes of light and beauty.

A million sleepless lids, they say,
Will be at least a warning;
And so the flowers would watch by day,
The stars from eve to morning.

On hill and prairie, field and lawn,
Their dewy eyes upturning,
The flowers still watch from reddening dawn
Till Western skies are burning.

Alas! each hour of daylight tells
A tale of shame so crushing,
That some turn white as sea-bleached shells,
And some are always blushing.

But when the patient stars look down
On all their light discovers,
The traitor's smile, the murderer's frown
The lips of lying lovers,

They try to shut their saddening eyes,
And in the vain endeavour
We see them twinkling in the skies,
And so they wink for ever.

THE DISCONTENTED APPLES

Mr. Frederic E. Weatherly is the author of this light and amusing little poem, which is not without a serious lesson that may be laid to heart by discontented young folk.

HE was an apple and she was an apple,
And they hung on an old brown tree;
And a fonder little couple
I trow you never would see.

But, alas! this little couple
They could not contented be;
"I should like to travel," she whispered,
"I wish that we could," said he.

But the summer went by so quickly,
And they still hung there on the tree:
For people can't always travel,
And apples are apples, you see. [grumbled

And they sighed, and they groaned, and
At the home that they once loved well;
Till there came a great wind through the orchard,
And down on the ground they fell.

"Oh, dear, what a bump!" she whispered,
"I'm bruised all over," said he;
But if people at home won't tarry,
They must get a few bumps, you see.

Then they found themselves put in a basket.
"We're off to the world," said she;
"I wish we were back in the orchard,
If this is the world," said he.

And this poor little couple
Were put in a dark big pie;
"Oh, love," sighed the wife to her husband,
"I think we are going to die."

And the oven grew hotter and hotter.
And they died, with a dream of home;
"Why didn't we stay in the orchard?
Oh, why did we want to roam?"

WILLIE'S LODGER *

It is often said that in each of us there are really two characters, a good and a bad one. Mary Mapes Dodge, the American writer, in this clever children's poem takes this idea for her subject, and the result is an excellent lesson in how to guard against the worse of our two characters getting the upper hand. The verses are reprinted from "Rhymes and Jingles," by permission of Messrs. Chas. Scribner's Sons.

TWO little boys named Willie
Live in the house with me.
One is as good a darling
As ever I wish to see;
His eyes are glad, his smile is sweet,
His voice is kind, his dress is neat,
And he is the boy for me.

This Willie says: "Good-morning!"
Happy as any bird;
A merrier laugh, a lighter step,
No mortal ever heard.
"Thank you," he says, and "If you please?"
He will not pout, he will not tease—
Oh, he is the boy for me!

The other Willie, sad to say,
Is very, very bad;
I think he is as cross a child
As ever a mother had.
"Go 'way!" he shrieks. He squalls and cries,
The angry tears oft fill his eyes—
He is not the boy for me.

He lingers round my Willie,
And whispers evil things—
Oh, how we dread him! for we know
The sin and grief he brings!
Who keeps him, then? Why, Willie's self;
He keeps this wicked Willie-elf
Who is not the boy for me.

If I were you, my Willie,
I'd make him stay away—
This boy who grieves your mother
And spoils your brightest day,
For he lives in you where he doesn't belong;
So oust him, Willie! Send him along!
"Clear out!" I'd say, "old Fume and Fret!
This heart of mine is not to let—
You're not the boy for me."

WHAT MIGHT HAVE BEEN

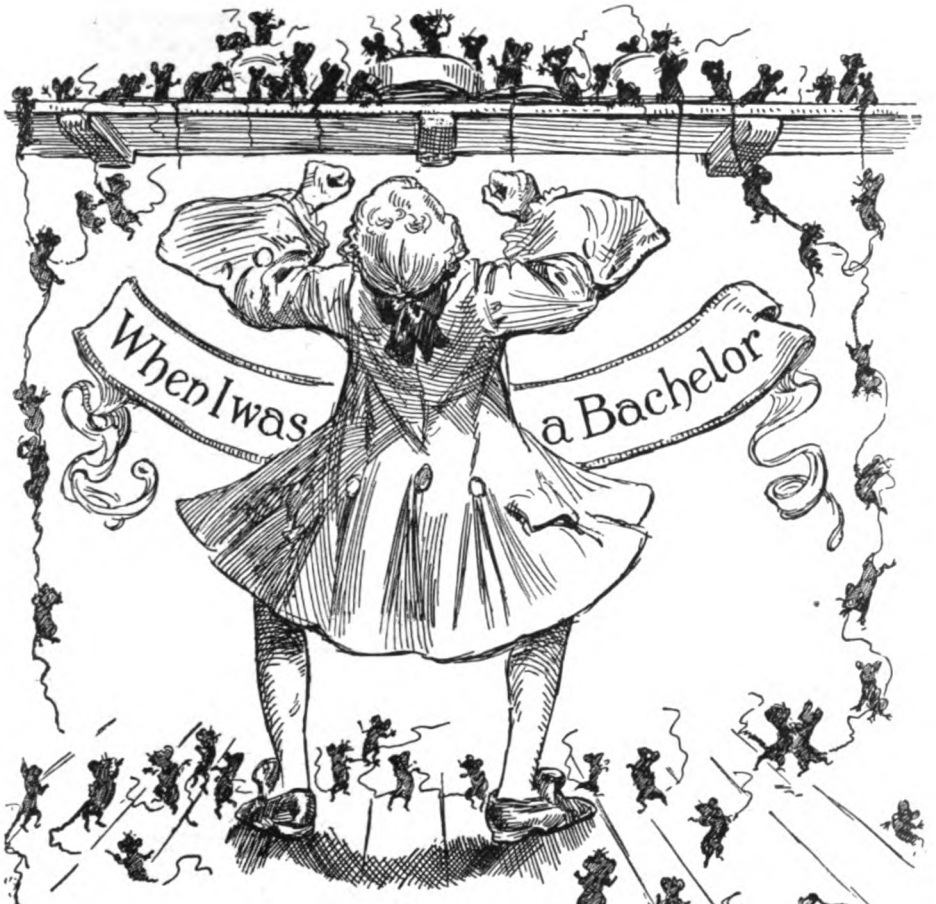
In these amusing verses, by Mr. Frederic E. Weatherly, we have the reverse of the state of mind described by the same writer in "The Discontented Apples," on this page, and all will agree that the contentment of which he sings here is much better than the discontent of the apples.

THE little birds are singing
Above their speckled eggs,
The daddy-long-legs talks about
His children's lovely legs;

The red cow thinks her little calf
The best that there can be,
And my papa and my mamma
Are very proud of me!

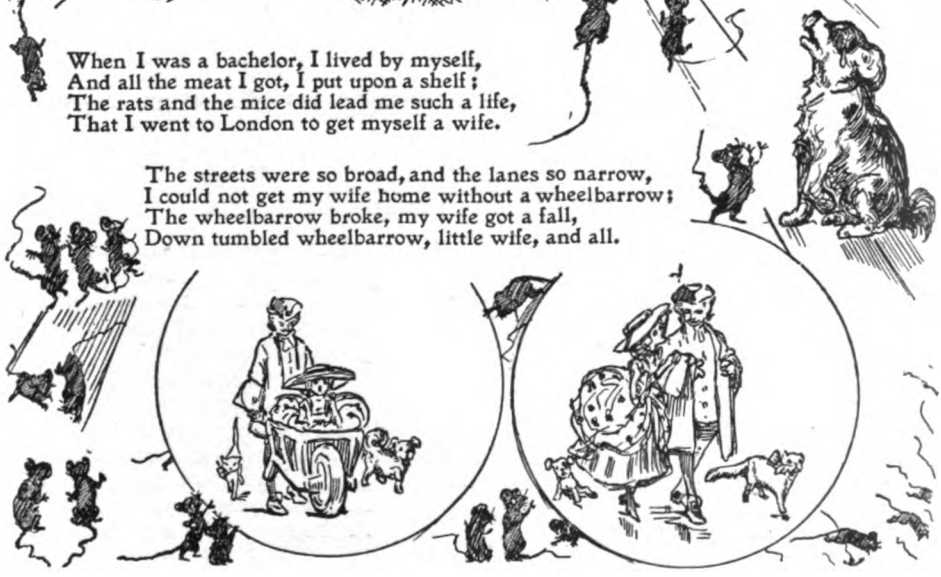
And yet I might have been a bird,
And slept within a nest,
Or been a daddy-long-legs,
With scarcely any chest;

Or been a little calf or pig,
And grown to beef or ham;
I'm very, very, very glad
That I am what I am!



When I was a bachelor, I lived by myself,
And all the meat I got, I put upon a shelf;
The rats and the mice did lead me such a life,
That I went to London to get myself a wife.

The streets were so broad, and the lanes so narrow,
I could not get my wife home without a wheelbarrow;
The wheelbarrow broke, my wife got a fall,
Down tumbled wheelbarrow, little wife, and all.

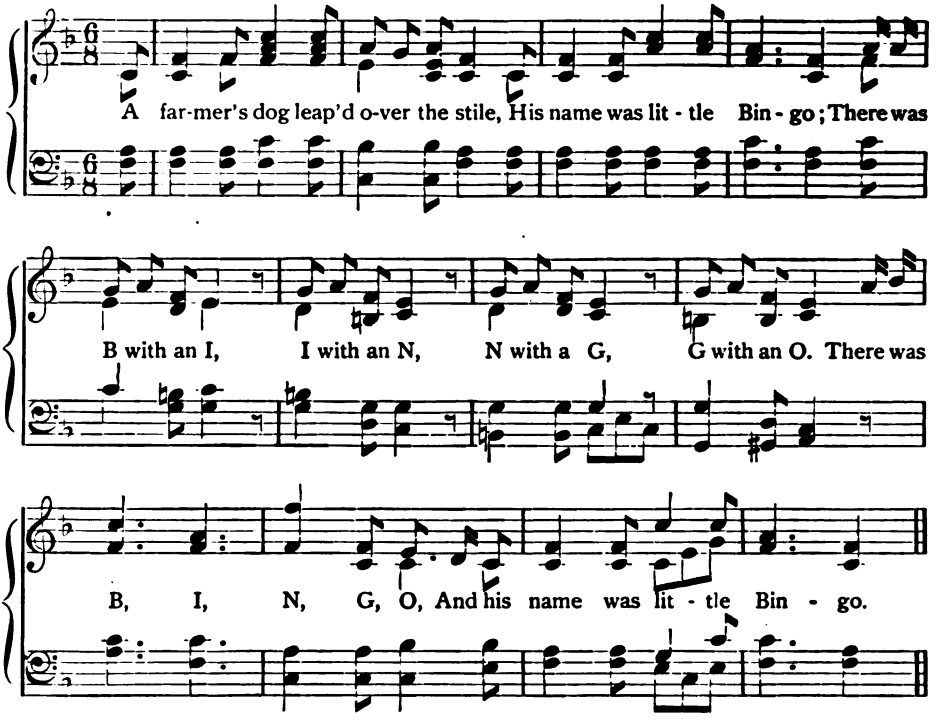


SOME little mice sat in a barn to spin;
Pussy came by, and she popped her head in.
"Shall I come in and cut off your threads?"
"Oh, no, kind sir; you will snap off our heads!"
"Oh, no, I'll not; I'll help you spin."
"That may be so; but you won't come in."

GOOD-MORROW to you, Valentine!
Curl your locks as I do mine;
Two before and three behind;
Good-morrow to you, Valentine!

I HAVE seen you, little mouse,
Running all about the house,
Through the hole, your little eye
In the wainscot, peeping sly,
Hoping soon some crumbs to steal,
To make quite a hearty meal.
Look before you venture out,
See if pussy is about,
If she's gone, you'll quickly run
To the larder for some fun,
Round about the dishes creep,
Taking into each a peep,
To choose the daintiest that's there,
Spoiling things, you do not care.

LITTLE BINGO



THE girl in the lane, that couldn't speak plain,
Cried gobble, gobble, gobble;
The man on the hill, that couldn't stand still,
Went hobble, hobble, hobble.

THERE was a little boy went into a field,
And lay down on some hay;
An owl came out and flew about,
And the little boy ran away.

LITTLE Betty Winkle she had a little pig,
It was a little pig, not very big;
When he was alive he lived in clover,
But now he's dead, and that's all over.
Johnny Winkle he
Sat down and cried;
Betty Winkle she
Lay down and died;
So there was an end of one, two, and three,
Johnny Winkle he,
Betty Winkle she,
And Piggy Wiggie!

WHAT THIS STORY TELLS US

THROUGH the meanest streets of New York, on a bitter winter's day, passed a great lady with a parcel in her hand. Poor people, shivering at street corners, turned to look after her. She was very beautiful, and she wore an ulster of costly furs. She entered a house, and was affectionately greeted by a poor woman. "Emmy's a deal better since you saw her last, ma'am," she said, and led the way upstairs. A little girl lay in bed. Her eyes brightened at sight of the lady. She stretched out both her arms and smiled and blushed, and could not speak because she was so glad. "I have brought you a doll, Emmy," the lady said, putting the parcel on the bed. "What a lovely soft coat!' said the child; and she rested her cheek against the fur. "Would you like me to tell you the story of this coat?" asked the lady. "Everything has a story, Emmy, and the story of this coat is a very interesting one. I will tell it to you before you open your parcel." This page tells the story the lady told to Emmy.

THE STORY OF A FUR COAT

CONTINUED FROM 2519

"ONCE upon a time there was a man who knew that people in New York wanted warm coats in the winter, and thought he would earn money for his wife and children by getting the furs of wild animals. Now, the wild animals whose skins are the warmest live in countries that are very cold; so very cold, in fact, that they are quite desolate. So this man journeyed a great way till he came to these cold countries, and there he began to hunt wild animals. When he had killed an animal he could not carry its skin to New York. That would have been absurd. But, while he hunted, other men came and said: 'We will buy your skins and send them to New York.' These other men began to build towns as near to the hunter as they could, and the hunter engaged Indians to help him, and soon there were hundreds of people earning their living in that desolate place by hunting animals. Great cities arose behind the hunter; railways were laid across barren land to reach him; mighty steamers came into waters where no man had been seen before, in order to be near the hunter. A fur coat in New York had unlocked the gates of a new world.

"You are resting your little cheek, here in New York, against the fur of an animal that once ranged a desolate country far beyond any trace of humanity. If this animal had not lived there, that country would have remained desolate to this day. My ulster tells you a story of adventure, and adventure is the story of trade. The fur-trader is a great explorer, a great world-opener; and if women in New York were content with sheep-skins instead of fur coats, there would now be a vast quarter of the globe untrodden by the foot of man, thousands of people out of work, and hundreds of cities unbuilt. Think of all the courage and excitement, all the difficulty and danger, all the business and employment, which have been brought into being by this warm coat.

"A wild animal in the land of eternal snow sets the telephone-bell ringing in New York, the steamship building on the Clyde, and the human race marching to possess new worlds.

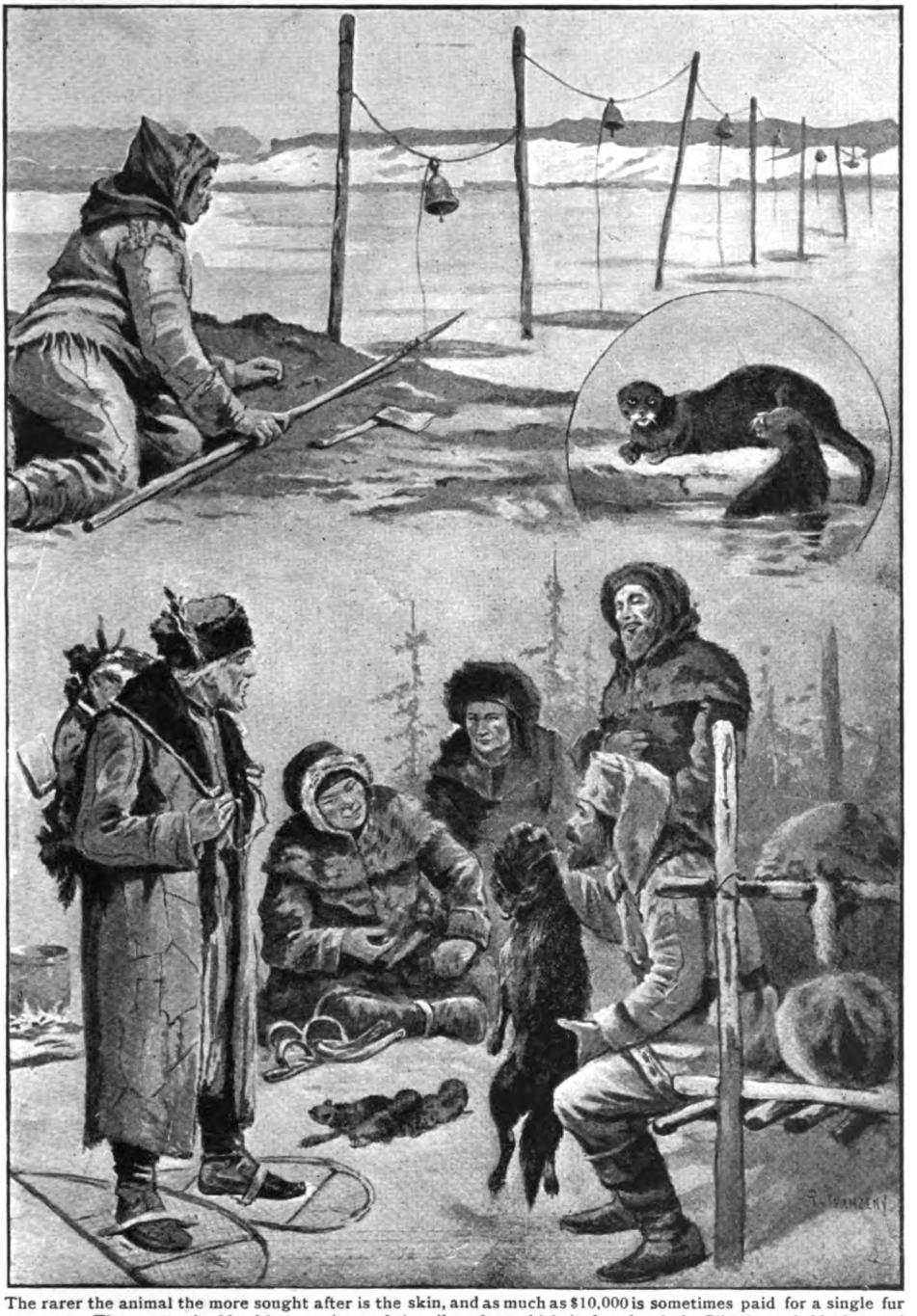
"And what do you think? One of these days a copy of THE CHILDREN'S ENCYCLOPÆDIA will be sent to a family living in the ice and snow about the North Pole! The children of the hunter and fur-trader will read in the rough huts among the eternal snow, while the howling of wolves sound in the frosty air, the very same articles and stories which you read in New York."

"And this beautiful soft coat," said Emmy, stroking the garment, "once upon a time had a great beast inside it; and now it has got an angel!"

WHERE THE WARM FURS COME FROM

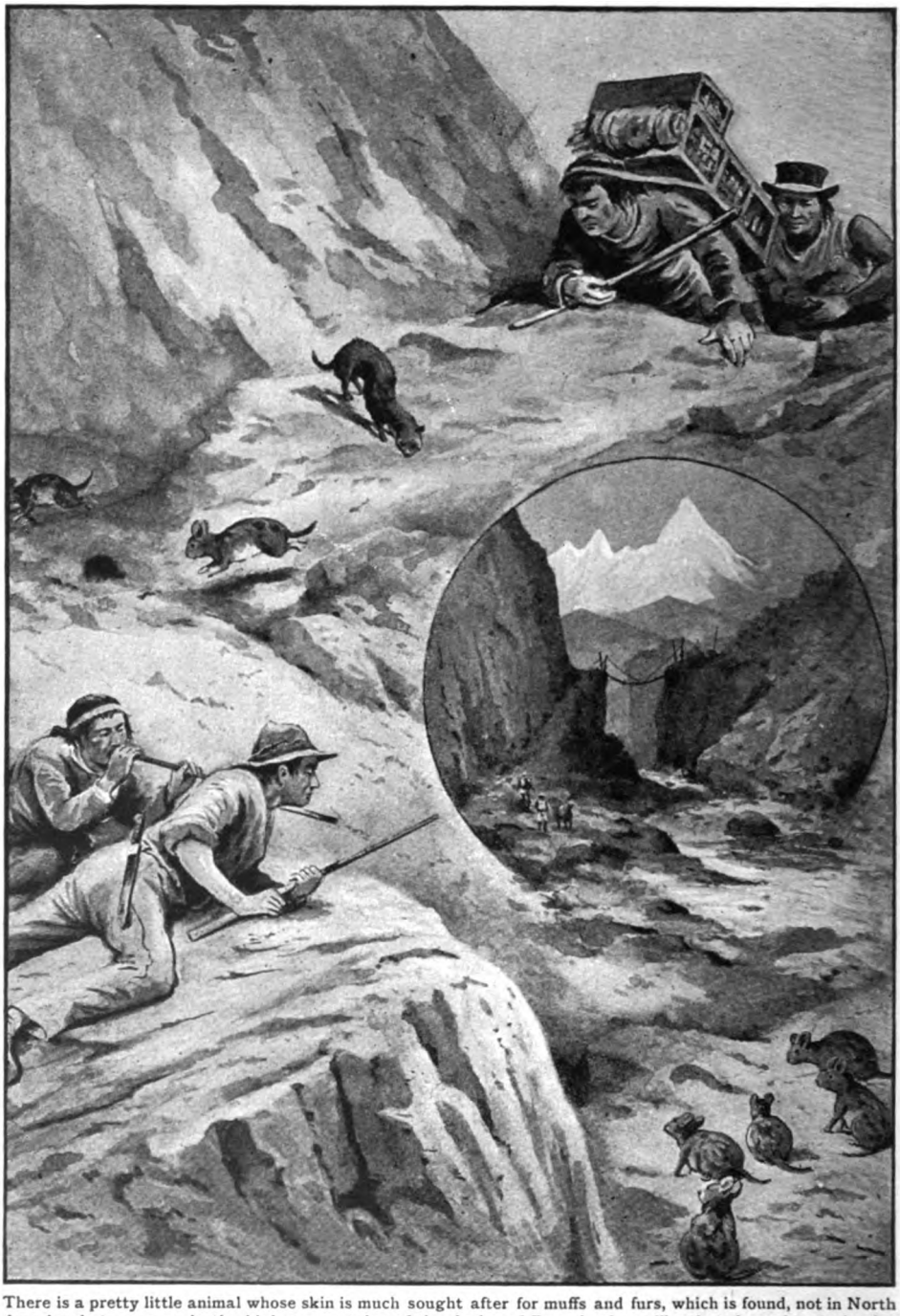
Although it may seem strange, fashions in dress have played a very important part in the exploration of the world. This is particularly true of North America, for it was the demand for handsome furs that led intrepid men to risk their lives for the sake of the wealth which rare and beautiful skins would bring. The pioneer in Canada and Alaska has always been the hunter and the trapper, farmers and townsmen following in the way they marked out. In Northern Canada the fur trade is now in the hands of the historic Hudson Bay Company, and the trappers, both white men and Red Indians, bring the skins to the company's stations, as shown in this picture. In the top left-hand corner we see Fort Chypewyan, the headquarters of the trade, and on the right are trappers returning from the winter's campaign. The trapper's life is one of great hardship and privation.

THE OTTER THAT RINGS IN ITS OWN DOOM



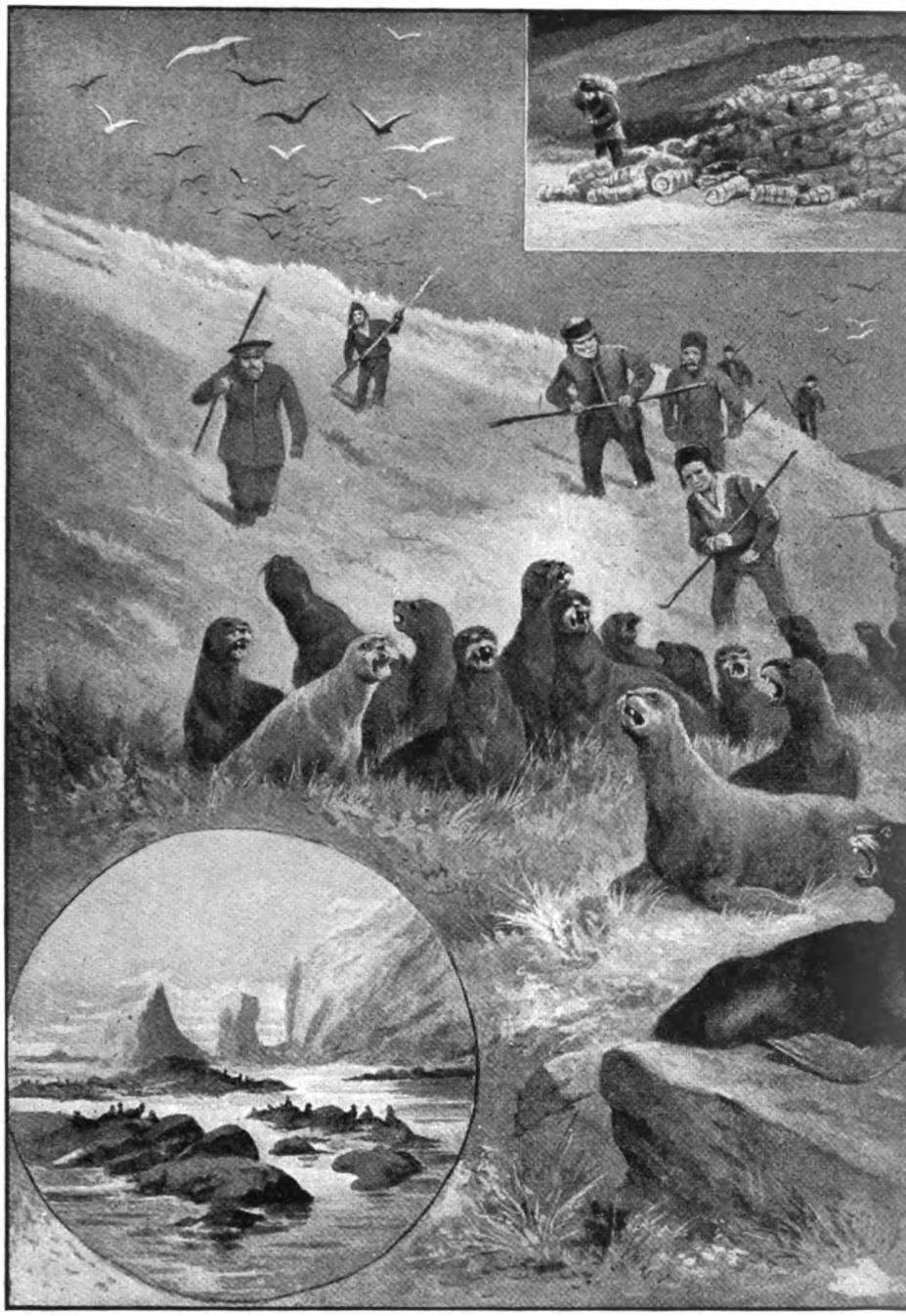
The rarer the animal the more sought after is the skin, and as much as $10,000 is sometimes paid for a single fur garment. The most valuable skins are those of the silver fox, which is found only in Siberia and Alaska, and the almost extinct sea-otter, found in Kamschatka and Alaska. Here, in the upper picture, we see an Eskimo **waiting, spear in hand, for the sea-otter, and these hunters will sometimes remain motionless in one position for hours at a time. The bells, with strings connecting them with the bed of the shallow sea-way, are to give warning of the presence of the otter, and directly a bell rings the hunter raises his spear, ready to strike. The small circular picture shows us what the sea-otter is like. Below, a fur-trader is shown bargaining with the trappers for the skin of a silver fox. Compared with the prices of the skins when made into garments, the trappers receive very little.**

CHINCHILLA HUNTERS IN THE MOUNTAINS



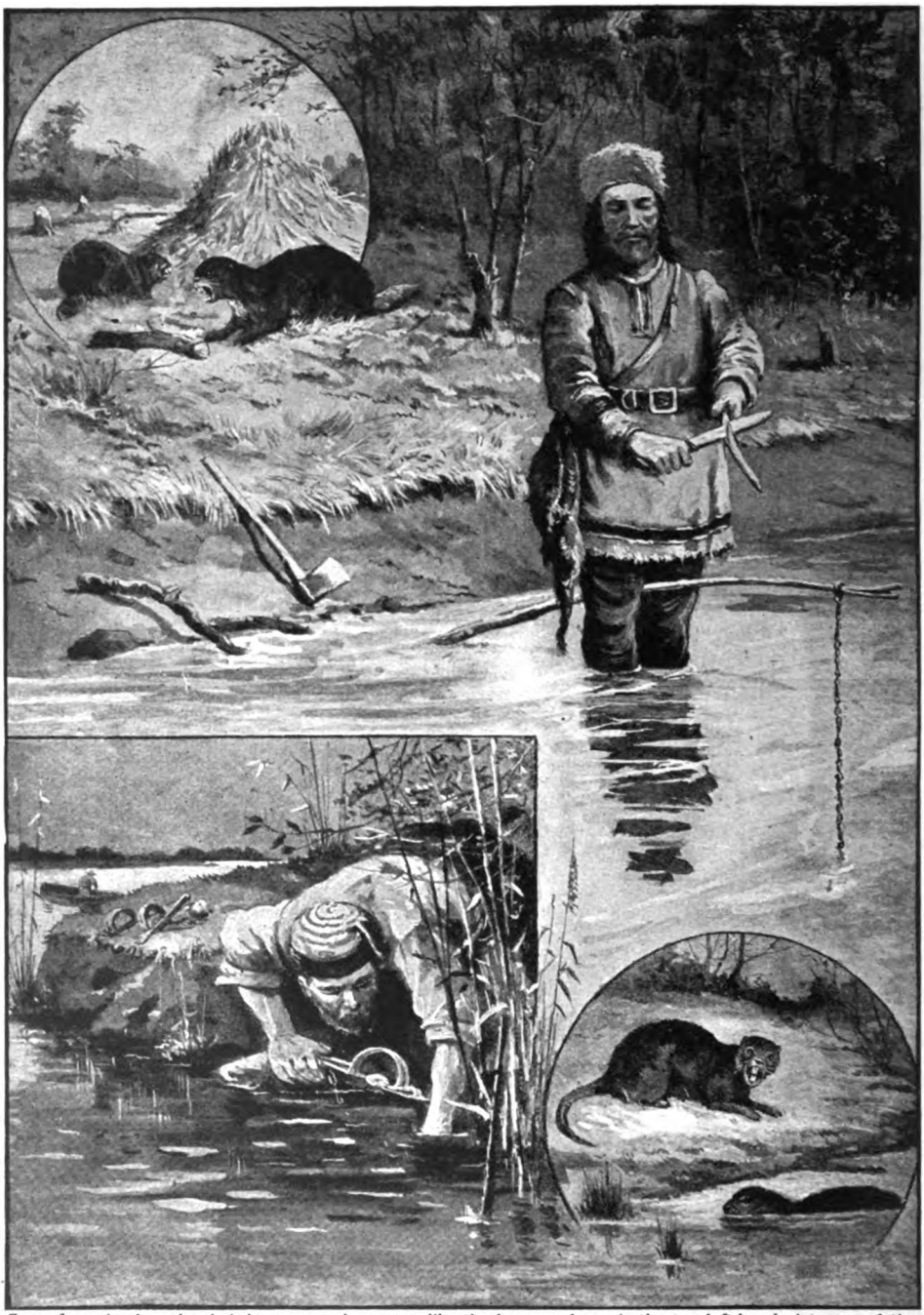
There is a pretty little animal whose skin is much sought after for muffs and furs, which is found, not in North America, but away up in the higher mountains of the Andes of Peru, in places like that shown in our circular picture. It is called the chinchilla, and is a near relation of the guinea-pig, though it looks more like a squirrel, runs like a mouse, and is the size of a rabbit. Its fur is very soft, and is a delicate grey in colour, mottled with black. Great skill is needed in hunting the chinchilla so as not to damage its skin. Sometimes the natives of Peru take a ferret, and, as soon as the chinchilla appears, let the ferret loose, when it kills the animal instantly; at other times they use a long tube, called a blow-gun, from which a tiny dart is blown with the mouth.

FUR HUNTERS IN THE HOME OF THE SEAL



The seal is the most important of all fur-bearing animals because of its size and numbers. But a few years ago the hunters nearly exterminated the seal, and in three years over four and a half million seals were killed. Now, however, the British and American Governments protect this valuable animal, and only a certain number may be killed in one year, and these only in certain places. On arriving at the sealing grounds, the sailors land, drive the seals inland, and there kill them. The seals are skinned, and the skins salted to preserve them, and then wrapped up in bundles, as shown in the top picture. They are shipped to various countries, and made into the beautiful furs that we know. Copper Island, shown in the circle, is a favourite haunt of the seal in the Behring Sea.

TRAPPING FUR ANIMALS UNDER WATER



Some fur animals make their burrows under water, like the beaver, shown in the top left-hand picture, and the musk-rat, seen below. Traps have to be set under water, and here we see how the hunters work. **The beaver trap is a noose fastened to a branch, so arranged that directly the beaver's head is in the loop the branch springs up and the animal is caught. The musk-rat, which gets its name from its strong musky smell, is captured in snap-up spring traps. The beaver's fur is chestnut brown in colour, and is very close and warm. It was formerly used for making tall hats, and if silk had not been thought of for this purpose, the demand for beaver would have been so great that the animal would have been extinct now. They are becoming rare in the United States.**

THE NEXT PICTURES OF FAMILIAR THINGS BEGIN ON PAGE 2835

THE REAL FAIRY OF CLAREMONT

CONTINUED FROM 2632

By quiet deeds of kindness, Princess Charlotte, the granddaughter of George III., had endeared herself to the people, and when she died, soon after her marriage, the whole nation grieved at the loss of a good woman who would one day have sat on the throne of England.

One thing that was very sensible in the Princess Charlotte was that she did not give to people without finding out all about their need. Of course, she was a rich princess, but she would neither give money in charity, nor give her custom to tradesmen, without being sure that she was doing the right thing.

One day, when she was living at Claremont, the Royal residence in Surrey, the princess had to choose a butcher who should serve the household with meat. Several men applied for the Royal favour, but she found that they were all well-to-do butchers, to whom it did not much matter whether they served her or not. So she asked her steward if there were no other butchers living in the district. He could not remember any at first, but after a time he did think of one poor butcher. This man had a very small business, so the steward thought it would be quite impossible for him to carry out the contract to serve the household with meat. He would not have enough money to trade with. But this fact did not baffle the princess. She expressed a wish to see him, and so he was summoned to her presence. He was much surprised at being asked to call at the house, and still more surprised when he found why the princess wanted to see him.

However, directly he saw the princess he knew that he was going to receive only kindness at her hands. She smiled at him, and questioned him about his business in such a friendly way that he told her all about his struggles, and how he had not dreamed of applying for the contract to supply her household with meat.

"How much money would you need to be able to buy in the market on the same terms as the more wealthy butchers?" asked the princess.

But the butcher hesitated to answer. He saw what the princess wanted to do, and, though poor, he had self-respect, and did not want charity. Yet there was the gracious princess smiling at him and asking again: "How much would you need?" So at last he named the amount that he thought would be sufficient.

"You shall have it," said the princess, and added, as though she were accepting a kindness: "From this time you shall supply my household."

And the poor butcher had no longer to struggle against poverty. His children were properly fed, clothed, and educated, and when he grew old he had enough money saved to live upon comfortably to the end of his days.

THE BRAVE MAID OF THE MILL

In a small village near Bonn, on the Rhine, there is a mill which, on a Sunday long ago, was left in charge of a servant-maid named Hänchen while the miller and his family went to church. The youngest child—a boy of five—being too young to go to church, stayed with Hänchen.

Now, Hänchen was sought in marriage by a worthless fellow called Botteler; but Hänchen did not believe the bad tales about him, and on this Sunday morning, when he knocked at the door, she let him in and gave him food. He dropped his knife, and, when the girl stooped to pick it up, gripped her by the neck and threatened to stab her if she did not tell where her master's money was. In a moment she knew his real character; but, instead of yielding to fear, her courage rose while a hundred plans rushed through her brain. She could hardly speak, but managed to make him understand that she would yield to his wish as she had no choice. Then she led the way to her master's bedroom and the box where he kept his money. Putting an axe in his hand for him to open it with, she said she would hurry upstairs and collect some clothes and her money, for she dared not stay after betraying her master.

But Hänchen returned to her master's room another way and bolted the robber in. Then she ran downstairs and out at the front door to find help. She saw the little boy, and told him to run to meet his father, and say that he must come quickly or something dreadful would happen. The little fellow, young as he was, understood, and ran off at her bidding. Suddenly, however, she heard a whistle, looked up, and saw her prisoner signalling to someone to catch the child. Then, to her horror, as the little fellow ran on, she saw a man spring up from the ground, snatch up the child, and run back to the mill.

Hänchen at once recovered her presence of mind. She must save the child now as well as herself and the house. Her courage rose; her nerves became like iron. She went back hastily into the mill, locked and bolted the door.

Soon the man who had snatched up the child clamoured to be let in. He threatened the screaming boy with a knife, and said he would break down the door. But Hänchen trusted in God.

Then the man Botteler called to his accomplice to kill the child. Poor Hänchen shuddered at that; but she reasoned that the child's death could be no gain to them, and rightly judged this to be a mere threat. Then the robber outside threatened to burn down the mill, and put down the child to go and carry out his threat. In peering round the mill, he found the big hole where the wheel was; so he returned to bind the child with a piece of rope, and went back to creep into the mill that way.

Meanwhile, Hänchen thought that if she set the sails of the mill in motion the neighbours in the country round would know that something was wrong. She had seen the machinery worked, so she flew to the engine and set it going. Slowly at first, then faster and faster it went, but she little knew that the robber had squeezed himself into the drum-wheel. There he was, whirling round and round, unable to stop the machinery, and there he whirled until he grew giddy and senseless. But though she at last heard his cries, Hänchen dared not let him out of his terrible prison, and she knew he would not get killed. Then the brave girl waited and waited, till it seemed as though her master were never coming and no one had understood her signal of distress.

At last! A loud knocking at the door! There were Hänchen's master and some of the neighbours, who had come to find out why the mill was working. They had found the child bound on the grass, but too frightened to tell what was the matter. Hänchen managed to tell them and then she fainted.

The brave girl had done her duty, and left the rest to her master and his friends. They secured the two robbers. The one in the mill-drum was recovered, and both were bound and taken to Bonn. There they were punished for their evil deeds. But the miller's eldest son married the brave Hänchen, and she lived all her life in the mill which her wits had saved from destruction.

THE NEXT GOLDEN DEEDS ARE ON PAGE 2803

BEAUTY AND THE BEAST

CONTINUED FROM 2608

A RICH merchant had three daughters. The two elder ones were cross and ugly, but the youngest daughter was so sweet and lovely that she was called Beauty. But the day came when the merchant lost nearly all his money. He had to sell his grand house and go to live with his daughters in a little cottage. He was too poor to keep any servants, but Beauty willingly undertook all the work of the house, and even tried to find excuses for her lazy sisters when they stayed in bed till quite late in the morning and allowed their younger sister to wait on them all day long.

One day, while the merchant worked in his garden, a letter was handed to him. He opened it, and learned that if he could go to a distant town he would be able to obtain work. Overjoyed at his good fortune, the merchant embraced his daughters, and prepared to set out.

"What shall I bring you when I return?" he asked Beauty.

"I want a new dress," cried both the elder daughters before Beauty could answer.

"I will bring you the best that I can afford, my daughters," replied the merchant. "And you, Beauty, what would you have?"

Beauty knew that it pained her father to feel that he no longer had the means to buy costly presents for his children, so she said quietly: "A rose, father, just a beautiful rose, if you can find one," thinking that such a present would cost him nothing.

So the merchant set out, and, after travelling for a whole day, reached the town to which he was journeying, and received his orders. The following day he prepared to return, but he had not gone far when, to his dismay, he discovered that he had taken the wrong turning. He was in the midst of a huge forest, and knew it was very unlikely that he would meet anybody of whom he could inquire his way.

After searching in vain for the right path for many hours, a terrible storm arose, and the merchant, in despair, climbed up into a tree in the hope of finding a light to guide him to some house. Sure enough, he saw a light, and, regaining the ground quickly, he leapt upon his horse and was soon before the gates of a magnificent castle.

For a moment he waited, but as nobody appeared he dismounted and strode up the steps. The house was brilliantly lighted from top to bottom, and on every side were signs of wealth and luxury.

The merchant passed through the great hall, blazing with lights, and found himself in a fine room. In the centre stood a table loaded with good things, and the merchant, being very hungry, sat down and made a good meal. When he had finished, he

began to feel very sleepy. Opening a door at the end of the room, the merchant found himself in a comfortable bedroom. He undressed and got into bed, and soon fell asleep.

In the morning, to his intense astonishment, he found a new suit of clothes in the place where he had left his old ones. He thought this strange, but he put them on and made his way to the dining-room, where he found breakfast awaiting him.

When he had finished an excellent meal, he rose and wandered out into the garden. The flowers were magnificent, and the sight of a lovely rose-tree reminded him of his youngest daughter's request. Stooping, he cut a lovely bud, and placed it in his coat. Just then he heard a noise, and, looking up, found himself face to face with the ugliest man he had ever seen, for though he had a man's body, the face was that of a beast.

The merchant shuddered.

"Ungrateful man!" roared the Beast. "Did I not feed you when you were hungry, and shelter you for the night? And yet you repay me by robbing me of my flowers. Ingratitude is a sin I cannot pardon; in an hour from this time you must die!"

"Forgive me, I pray you!" cried the merchant, falling on his knees. "I did but pick a rose for my daughter, and could I have found you sooner, I would have thanked you for all your kindness."

After some pleading, the Beast consented to forgive the poor man if he would promise to send in his place the first living thing he saw on returning to his home; and the merchant, hoping that this would be his dog, who always ran to welcome his master long before anyone else had heard his footsteps, gladly promised, and departed.

To his horror, his first sight as he drew near the house was Beauty.

"Oh, what a beautiful rose!" she exclaimed, kissing him.

"Alas!" replied the poor man sadly, "you little know how dear it has cost me." And drawing her to him, he led her inside and told her the whole story.

"What you will do when I am gone, my poor children," he concluded, "I do not know."

"But you are not going," declared Beauty bravely, "for I shall go instead." And in spite of everything that the merchant could say, Beauty insisted on having her own way.

And so the next day they both set out for the castle, where they found a splendid supper awaiting them. They sat down to eat, and had scarcely finished when the Beast appeared. He looked at Beauty, and Beauty lifted her eyes and saw him. She shuddered and moved closer to her father. "What a dreadful man!" she was thinking. "I do hope he will kill me quickly."

But the Beast did not want to kill one so lovely, and he told her father that if he would go home and leave her behind, no harm should befall her

So the merchant rode sadly away, and Beauty was left alone in the huge castle. But the Beast scarcely went near her all day, and when night came he showed her a beautiful little room, which he told her was hers. Sure enough, on the door was written "Beauty's Room," and inside was everything she could wish for. That night Beauty dreamed that a fairy came to her and bade her be not afraid, for she was quite safe.

The next morning she rose early and wandered through the gardens, but not one single person did she see. When she felt hungry she went to the dining-room, where she met the Beast.

"Do you think me very ugly?" asked the Beast.

"Well—yes," replied Beauty.

He spoke so gently that she felt quite sorry for him.

The Beast sighed and left her. The next day she met him again.

"Will you marry me, Beauty?" said the Beast.

"Oh, no, no, no!" cried Beauty, for, much as she pitied him, she could not bear the thought of marrying him, and the Beast went away looking very unhappy.

Soon after this, Beauty looked into a magic glass, and saw that her father was very ill. The next time she met the Beast again she begged to be allowed to visit her home.

"If you go away, it will kill me," said the Beast; "but rather than see you unhappy, I would bear any pain. Go, but you must return in a week."

At parting, the Beast gave her a magic ring, which would take her home and bring her back again when she wished to return, and Beauty was

BEAUTY SAVES THE LIFE OF THE BEAST

"Oh, you must not die!" cried Beauty. "I will marry you, dear Beast, indeed I will, for it is surely better to be kind and gentle than to have a handsome face." And as she spoke a wonderful change came over the Beast.

surprised to find how sad the parting with the great, ugly creature made her.

Her father was so rejoiced to see his daughter alive and well that he quickly recovered, and Beauty was so happy to be at home again that she forgot all about her promise to the Beast. The week slipped by, and then another, until one night Beauty dreamed that the Beast was dead. She burst into tears and awoke. She dressed quickly, and with the aid of her ring was soon back again in her little room in the palace.

She ran out into the gardens, and there, in a swoon, by the fountain lay the Beast. Beauty threw some water upon his face, and presently he recovered. When he saw her, he smiled.

"I could not live without you," he said faintly, "and so I tried to starve myself to death."

"Oh, you must not die!" cried Beauty, wringing her hands. "I will marry you, dear Beast, indeed I will, for it is surely better to be kind and gentle than to have a handsome face."

As she spoke a wonderful change came over the Beast, and even as she looked the Beast was transformed into a handsome prince, with whom she instantly fell in love.

Beauty was so astonished that she could scarcely believe her eyes. Taking her hand, the young man explained that a wicked fairy had cast over him a spell, which could not be removed till some gentle girl should promise to marry him, ugly as he was.

Beauty's father was overjoyed to hear the good news, but the disagreeable sisters were as jealous as they could be, and said such unkind things to Beauty at the wedding that the Prince turned them into statues, and placed one at each side of the palace gates, where they stand, still and cold, to this day.

THE RIDDLE OF THE SPHINX

THERE was once a King of Thebes, in ancient Greece, of whom it was foretold that he would be killed by his own son. So, when a baby boy was born to him he had it carried far away to a wild forest, and left there to die. But it was all in vain. For Œdipus, as the child was called, was found in the forest by a herdsman, and taken to Corinth; and there he grew up, not knowing who was his real father. And one day he met the King of Thebes, and slew him as a foreign enemy.

Œdipus did not know what a great crime he had committed, and he was surprised to learn that the King of Thebes was dead, and that the crown was offered to any man who could manage to answer the riddle of the Sphinx.

The Sphinx was a strange monster that did great harm to the people. She had a woman's face, and the body and claws of a lioness, and she crouched on a hill near Thebes, waiting to kill all the men who should pass by, because none of them could answer her riddle. But Œdipus did not fear. He went boldly up to her, and said:

"Well, what is your riddle?"

"This," said the Sphinx. "There is a wondrous creature, and its like is not found on earth, in air, or in water. At first it goes on four legs, then it goes on two, and at last it goes on three."

"Man!" cried Œdipus.

And so it was. In infancy man crawls on four legs, then he walks on two, and when he grows old he uses a stick as a sort of third leg. When her riddle was solved, the Sphinx cast herself from the hill, and died, and the grateful people of Thebes crowned Œdipus as their king.

But one day Œdipus discovered that he was really the son of the man he had killed. This made him very unhappy, and he gave up his throne and wandered blindly about the country dressed in beggarly rags. But he had a tender and loving daughter, and she went with him and helped him and comforted him.

NOUREDDIN & THE WONDERFUL PERSIAN

WHEN the good Haroun Alraschid became Caliph of Bagdad, he made his cousin Zenebi, King of Balsora, and Zenebi then sought for a woman worthy to be his queen. He ordered his Minister to find him a maiden perfect in charm and beauty, and excellent in wit and intelligence.

For a long time the Minister tried in vain to discover this maiden, but one morning a merchant brought to his house a Persian slave-girl of great loveliness and marvellous gifts. The Minister gave the maid a set of rooms in his house, and resolved to introduce her to the King. But in the course of the day the Minister's son, Noureddin, saw her, and fell deeply in love with her, and she fell deeply in love with him, so that, when the Minister came to conduct her to the Royal palace, he found her sitting with Noureddin.

"Oh, unhappy boy!" he cried. "You have ruined me. The King will find this out."

But after struggling between his affection for his son and his duty to the King, the Minister gave way, and allowed Noureddin to marry the beautiful Persian. He then tried to keep the King quiet, by pointing out how hard it was to discover a maiden in whom great beauty and great wisdom were joined. But the King found out about the Persian maid, and sent his men to bring Noureddin and the maid to him.

Happily, a friend of Noureddin's heard the order, and hurried out and warned him, and Noureddin and the beautiful Persian at once fled from Balsora, and got on a ship sailing to Bagdad. When they arrived at Bagdad they did not know where to stay, as they had never been in this famous city before. After wandering about the crowded streets until they were tired, they entered a gate leading to a splendid garden, and sat down by a fountain, and fell asleep. At evening an old man came to the spot and woke them up.

"Pardon us, pray, for falling asleep," said Noureddin, when the old man came and woke them up at evening.

"Pardon us, pray, for falling asleep here," said Noureddin. "We are strangers in Bagdad, and we have walked about the city until we were tired. This garden is really the most delicious spot I have ever seen in my life. Oh, what a happy man you are to possess such a place!"

Now, the garden was really one of the pleasure-grounds of the great Caliph, and the old man was only one of the keepers. But he was so flattered at being taken for the owner of the place that he offered to show Noureddin and the beautiful Persian over the lordly pleasure-house which stood in the middle of the garden opposite the Royal palace. He led them up the golden staircase, into the great hall built of jasper, and adorned with the richest treasures of the kingdom. At the sight of all the splendour, Noureddin was filled with joy, and he gave the old man a handful of gold, saying:

"Do, please, allow me to provide a banquet this evening. Give this gold to one of your slaves, and get him to buy a supply of meats and fruits and wine."

The old man ran out into the streets and bought a rich repast, and returned with it to the pleasure-house, and Noureddin and the beautiful Persian lighted all the costly lamps by the eighty windows of the great hall, and then they sat down to the feast.

Now, the Caliph of Bagdad had a good view of the pleasure-house from his palace, and he was much surprised to see lights shining in all the windows of the great hall. Any other ruler would have sent some courtier to inquire into the matter, but Haroun Alraschid liked to see into things himself. Disguising himself as a beggar, he went into the garden, and crept up to the pleasure-house just as the beautiful Persian was singing to the sound of a lute.

"What a sweet voice!" he said. "I must certainly find a way to see this charming singer without making myself known."

As he was wondering what to do, he saw a man poaching fish in the river that ran through the garden.

"Have you caught any fish?" he inquired.

"Two," replied the poacher.

The Caliph bought them, and, entering the pleasure-house, said to Noureddin:

"I see you are holding a feast here, and as I have just caught two fine fish, I thought I would bring them to you."

"Very well," said Noureddin. "Go and fry them in the kitchen."

The Caliph did so, and returned with the fried fish, and served the three merry-makers with it.

When Noureddin had eaten his portion, he gave Haroun Alraschid a handful of gold, saying:

"Pray accept this small gift. I have never tasted a better cooked fish."

The Caliph took the gold, and thanked Noureddin, and said:

"And now may I ask a great favour? I should very much like to hear your lovely wife sing a song."

The beautiful Persian at once took up her lute and sang song after song, and the Caliph listened to her with exceeding delight. And in between the songs Noureddin related to him the story of his marriage and his flight. Haroun Alraschid then told Noureddin that he himself was really the Caliph, and he sent a letter to King Zenebi commanding him to retire from the throne, and made Noureddin and the beautiful Persian, King and Queen of Balsora.

THE LUCK OF SIMPLE JACK

Simple Jack was the best silk weaver in Spitalfields, but he had not the least idea of the value of money. If he went out with plenty of silver in his pocket, he was sure to spend it, either upon his friends, who used to crowd round him, or in buying very many things for himself and his wife that were of no use at all.

And not only did Simple Jack do this, but he would pay whatever the seller asked for any article; and, as the people all knew his weak points, Simple Jack was swindled whenever he went out to buy. He was just as silly if he wanted to sell, for then he would take whatever price was offered for his goods, no matter how absurdly low that price might be. So his wife used to do all the buying and selling that they needed.

But one day, Simple Jack resolved to go a-marketing himself. He took a bundle of fine silks and sold them to a merchant for £40 ($200). Then, seeing a man with a donkey, he said:

"That donkey would be useful to me. Will you take forty pounds for it?"

Of course, the man readily sold it at this high price. But Simple Jack found that the donkey was very obstinate, and it would not go the way he wanted.

"How much will you give me for this stubborn beast?" he said to a costermonger.

"It would be dear at ten shillings," said the artful costermonger.

Simple Jack took the ten shillings, and with the money he bought a sack of new potatoes. But the sack was very heavy, and Jack soon grew tired of his new bargain. So he exchanged it at a fish shop for a mackerel. Naturally his wife was very angry when he told her how he had spent the forty pounds. But on cutting the fish open, she found in it a great pearl of remarkable beauty.

"Why, this must be worth thousands of pounds!" she cried.

"There you are, my dear!" said Simple Jack merrily. "I spend a beggarly forty pounds in buying a fish containing a rich jewel, and yet you say that I have no idea of the value of money."

THE CALIPH BROUGHT THE FISH TO THE FEAS

"I see you are holding a feast here," said the Caliph to Noureddin, "and as I have just caught two fine fish thought I would bring them to you." "Very well," said Noureddin. "Go and fry them in the kitche

THE TREASURE OF THE POOR

THERE were once upon a time, according to a French story told by Jean Richepin, two very poor people who possessed nothing of anything. They had no bread to put in a bread-pan, and no bread-pan in which to put bread. They had no house in which to place a bread-pan, and no plot of ground on which to build a house. If they had possessed a plot of ground, they might have been able to find something wherewith to build a house. If they had possessed this house, they might have been able to place there a bread-pan. And if they had possessed this bread-pan, no doubt from time to time they would have been able to find a little bread to put in it.

But having neither field nor house, nor bread-pan nor bread, they were verily of the poor—very poor.

That which they most lacked was a little house of their own, where they could light a few dry sticks and sit over the blaze chatting together.

For the best thing in the world, better even than eating, is to possess four walls, without which a man is no more than a wandering animal.

These two poor people felt themselves poorer than ever one sad Christmas Eve.

As they were commiserating themselves on the great lonely high road in the black night, they stumbled upon a poor cat, who *mee-owed* to them.

This was truly a very poor cat, as poor as themselves, for it was nothing but skin and bone, and had scarcely any hairs on its skin.

If it had had some hairs on the skin, no doubt the skin would have been in a better state. If its skin had been in a better state, no doubt the cat would have been strong enough to catch mice, and would not have remained so dreadfully thin.

But not having any hairs, and with its poor skin on its bones, this was in truth a very poor cat.

The poor are kind to the poor, and help one another. These two poor people took the poor cat with them, and did not think of eating anything themselves, but gave to the cat a little lard which had been given to them in charity. The cat, having eaten, started off a little in front of the two poor people, and led them through the black night till they came to an old deserted hut.

There were two stools and a hearth in this hut, as they could see by a ray of moonlight, which shone and disappeared at the same time.

And the cat also disappeared with the moonlight.

So that they found themselves seated in darkness before a black hearth, which the absence of fire made still more black.

"Ah," said they, "if we only had a few embers! It is very cold! And what could be so pleasant as to sit warming ourselves over a bit of fire, telling stories?"

But there—there was no fire on the hearth because they were very poor people; in truth, of the poor, very poor.

All of a sudden there appeared two bright, glowing embers at the bottom of the chimney; two beautiful bits of fire—yellow, like gold.

And the old man clapped his hands joyously and said to his wife: "Do you feel how nice and hot it is?"

"I feel it," answered the old woman. And she spread her open palms over the fire. "Blow under them, and make them flare up," she said.

"No, no!" answered the man. "That would only burn them up quickly."

And so they began chatting to pass away the time, without sadness now, because they felt cheered up by the sight of two little yellow embers.

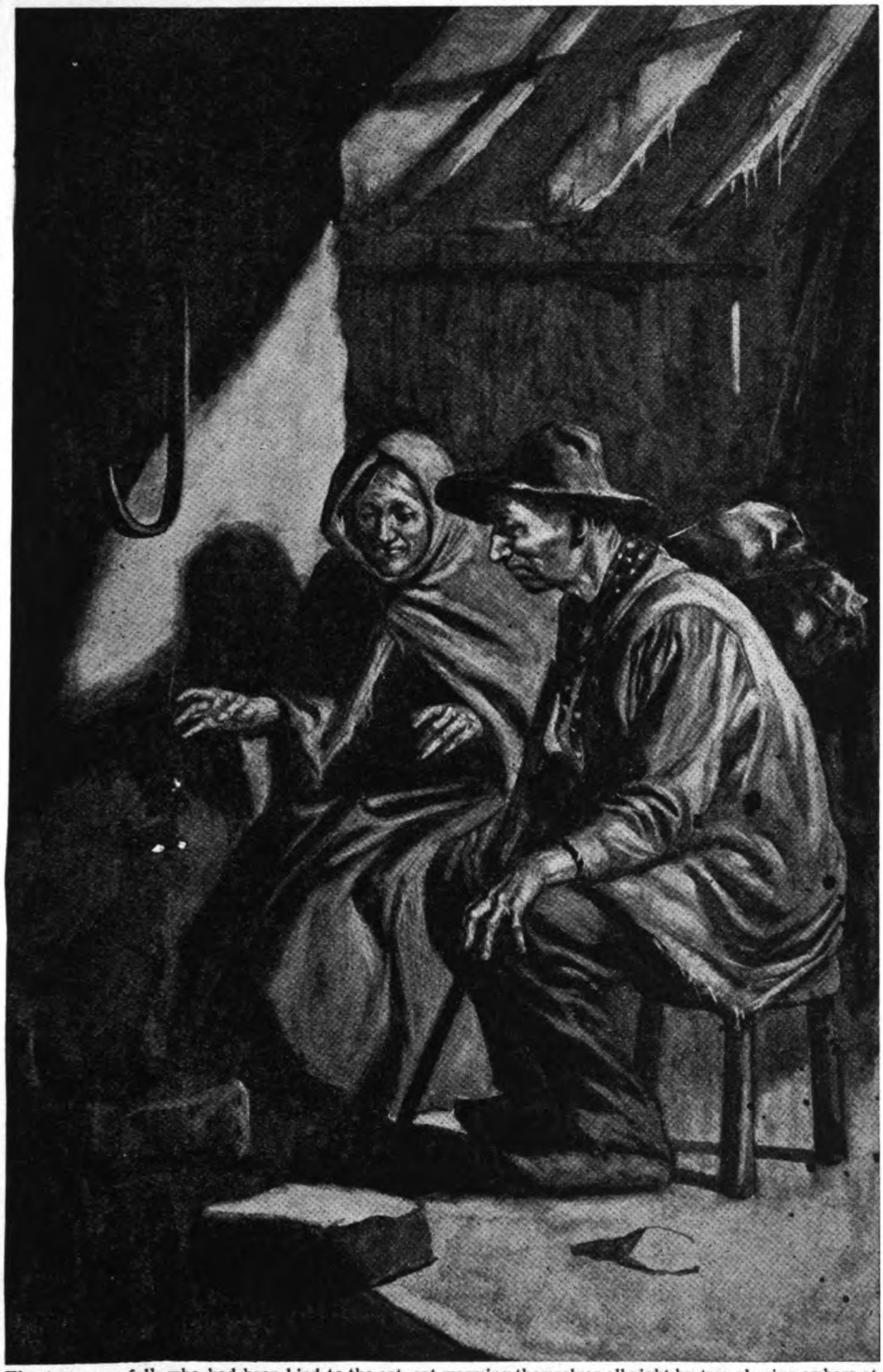
The poor are happy with very little, and these two rejoiced in seeing the beautiful present of fire which had come to them. Through the whole night they sat talking and warming themselves, quite certain now that the Child Christ wished them well; for these two shining embers remained mysteriously bright, and were never consumed.

And when morning came these two poor people, who had been quite warm and had been quite happy all night, saw at the bottom of the chimney the poor cat, who looked at them with its large yellow eyes.

And it was the reflection of its eyes which had kept these two poor people so warm and cheerful.

"The treasure of the poor is fancy," said the wise cat to them.

THE CAT LOOKED AT THEM WITH ITS YELLOW EYES



The two poor folk who had been kind to the cat, sat warming themselves all night by two glowing embers at the bottom of the hearth, and only discovered at dawn that they were but the reflection of the cat's eyes.

LEGENDS OF PLACES AND THINGS

THE PIGEON AND THE MAGPIE

You must never keep saying "I know, I know," when anybody is telling you anything. For that was what the wood-pigeon kept saying to the magpie.

The wood-pigeon is a silly, careless bird. All he has for a nest is an untidy heap of twigs, raked together on a forked bough. There he sits and shivers in wintry weather, and you can then hear him singing in a very doleful way:

When all the world's in flower,
I'll build a bonny bower
For two.

But when the green leaves come out, and the fields are bright with blossom, he forgets how cold he felt in winter, and he sings joyfully:

Now all the world's in flower,
Who'd ever waste an hour
In building of a bower?
Who? Who?

One spring morning, however, the magpie took pity on him, and began to show him how to make a nice, warm, snug nest. But all the time the silly wood-pigeon, who did not know a thing about nest-making, kept on saying

"I know, I know, I know!"

And at last the magpie got angry, and flew away, and said:

"Well, if you know so much, do it all yourself."

So the wood-pigeon still has only a few bits of twigs to make a nest for himself.

THE HERON, THE CAT, AND THE BRAMBLE BUSH

Once upon a time, and a very good time it was, though it was neither my time nor your time, nor anybody else's time, a heron, a cat, and a bramble bush found some fairy gold and bought a farm with it.

The heron took the hay as his share, and mowed it, and meant to carry it to market the next day. But in the night a storm came and blew the hay into the river, and it floated away. Ever since then the heron stands mournfully by the side of rivers and cries: "Pay me for my hay!"

The cat cut the oats and put them in a barn. But the storm drove all the rats and mice there for shelter, and they ate up all the oats. Ever since then the cat springs on every rat and mouse she sees, and cries: "Pay me for my oats!"

The bramble bush took the wheat, and harvested it, and carried it to market and sold it. Unhappily, the bramble bush sold on trust, and no one ever paid up. Ever since then the stupid bramble bush takes hold of everybody who passes by, and cries: "Pay me for my wheat! Pay me for my wheat!"

THE KING OF THE CATS

Some years ago, two brothers lived in a lonely farm in a lonely part of Scotland, and the only creature they had to keep them company was a great black cat. One night the younger brother came home late, and said:

"I've just seen the strangest sight on earth. I lost my way on the hills, and came to a hollow tree with a light in it. I looked down the tree, and there was fairyland. A funeral was taking place, and a host of cats were following a little coffin stamped with a crown and a sceptre. Whatever can it mean?"

"I know," said the great black cat. "Old Peter is dead, and hurrah! I'm now the King of the Cats!"

And the cat rushed up the chimney and never was seen on earth again.

THE WHITE COW

Mitchell's Fold is a circle of enchanted stones standing on a wild moor in West Shropshire. There, in days gone by, lived a white cow, and this white cow was the kindest and most wonderful creature that ever fed on grass.

She allowed anyone who came along to milk her, and, no matter how many persons came, she always had plenty of milk for all, so long as nobody took more than one pailful.

But one winter, when there was a grievous famine in the land, and everybody was living on the milk of the white cow, a spiteful old witch resolved to drive the gentle, fairy creature away, so that no one could get any milk.

Instead of bringing a pail, the old witch brought a sieve, and she milked, and milked, and milked, until she milked the white cow dry. The white cow at once vanished, and was never seen by mortal eye again, although some of the moorland people say that she changed herself into the tallest of the enchanted stones now standing in Mitchell's Fold.

HOW A SULTAN FOUND AN HONEST MAN

A SULTAN wanted to find an honest man to collect the taxes of his realm, but he did not know where to go for such a man, so he consulted a wise counsellor, who advised him to publish abroad his need, and then to invite all the applicants to his palace on a certain night to be arranged

"I will show you the honest officer when you ask them to dance," said the wise man.

The applicants arrived at the palace in due course, when they were told by an officer of the Court that they were to advance to the Sultan, one at a time, through a dark and empty corridor. As soon as they were all assembled before the throne, the Sultan said amiably:

"Gentlemen, I should very much like to see you dance. Please dance."

But all the applicants refused, with many blushes, except one man, who danced cheerfully and well.

"That is the honest man," said the sage, pointing to the dancer.

In the dark corridor the wise man had placed sacks of money, and all the dishonest men had filled their pockets as they passed through to the Sultan. If they had danced, their pockets would have sounded like money-boxes being shaken, and so they had refused.

THE KNIGHT AND THE WONDERFUL STONE

A BRAVE English knight in the Holy Land was captured by the Saracens and thrown into a dungeon to die. But a nightingale came and perched on the window of the dungeon, and cheered the knight with her song; and the knight fed her with some of his scanty food, and made a pet of her. He used to talk to her as if she were a human being, and one day he said:

"Ah, sweet bird! If only you could help me to escape!"

The nightingale at once flew away, and as she did not return for three days the knight thought she had been killed by some hawk. But on the night of the third day she flew back to the dark dungeon once again, carrying in her beak a strange stone. The knight took the stone, and, by accident, touched his fetters with it, and to his astonishment and delight they fell off. He then went to the dungeon door, and touched that also with the magic stone, and the door opened.

The knight lost no time in leaving his prison, and he managed to escape to England, to which country the nightingale followed him. There the knight showed his gratitude to his little feathered friend by building her a golden cage, with an open door, in the garden of his castle.

THE KING WHO CAME TO CASHMERE

MANY years ago a Prince and a Princess in India fell in love; but their fathers were at war, and would not let them marry. So the lovers ran away together and hid in a great forest.

But in the evening, as the Prince was looking for food, a robber rode away with the Princess. He put her in a cave, and went to sleep; and the Princess then arose and bound him, and, dressing herself in his clothes, mounted his horse and went in search of the Prince.

Instead of finding him, she came, in the morning, to the great city of Cashmere. All the streets were crowded with people who were anxiously watching an elephant. The king of the city and all his family were dead, and the people desired to find a new king to reign over them. Now, everybody in India believes that an elephant can tell who is of Royal blood, so the people had let an elephant loose, and they were waiting to see whom it would acknowledge as master.

To their surprise, it ran up to the disguised Princess, and knelt down before her. The people shouted for joy, and carried the Princess to the palace and crowned her king. She dressed up in kingly robes, and no one dreamt that she was not a man.

But when the Prince at last came to the city in search of her, she told the people that she was a Princess, and they made the Prince their king, and she married him and became queen.

THE NEXT STORIES BEGIN ON PAGE 2843

HAMBURG, THE HOME OF GERMAN COMMERCE, AND BERLIN, THE GERMAN CAPITAL

Hamburg, the greatest commercial centre and seaport in Germany, is shown in the upper picture. It is one of the four principal commercial cities of the world, and was founded by the Emperor Charlemagne. It is built on the River Elbe, and from its mighty docks great liners go to all parts of the world. The lower picture shows Berlin, the great political centre of Germany and the capital of Prussia and the empire. It is not an ancient city, but is gradually becoming one of the most imposing cities in Europe, with its many fine public buildings and monuments, and its splendid avenues and squares. In this view of the city, the domed building on the left is the new cathedral, and the one on the right is the royal palace.

The Unter den Linden, the great triumphal road in Berlin, named after its avenue of lime-trees.

GERMANY AS IT IS TO-DAY

CONTINUED FROM 2582

THE story of England and France all through the centuries is written plainly for those who have eyes to see, in the streets and buildings of their capitals. With Germany it is somewhat different. For the early chapters of its story we must turn, not to Berlin, but to the famous old cities of the various states that now form the German Empire.

In Berlin, the capital of Prussia and the empire, there is little that is more than about 200 years old. This immense and magnificent city, which has grown up in so short a time, filling up the valley of the Spree with palaces and factories, illustrates in a wonderful way the rise of Prussia and the founding of the empire under its leadership.

Ever since the days of the Great Elector, who first made elaborate plans for the city, and who planted the double avenue of lime-trees which has developed into a triumphal way for his successors, every ruler of Prussia has beautified the capital by adding fine streets and squares, and bridges, splendid palaces and museums, picture galleries and public buildings of all kinds. Miles of houses for rich and for poor have sprung up as the population has risen from a few thousands to over 2,000,000. And everywhere there are monuments and statues to keep in remembrance the men and the events that have helped to build up Prussia and the empire.

It takes at least three times as long to go from London to Berlin as it does to go from London to Paris, and after crossing the Channel it is a long, wearisome train journey through the great north plain. Lines from all parts converge upon Berlin, and within the well-kept city itself are railways and conveyances of every kind; for the Unter den Linden, as we have already seen, is a mile long, and the Thiergarten, the other side of the Brandenburg Gate, is a large park, and the suburbs lie widely distant.

Let us join one of the classes of children so often seen going round with their teachers, not only to look at the interesting collections in the perfectly-arranged museums and galleries, but to study the sculpture which records the faces as well as the names of the men who have made the history of their country. They stand round, eager and interested, as the teacher says a few words about the work of each. Most likely half the class will answer to the names of the rulers who have done so much for the city, Friedrich or Wilhelm, or Friedrich-Wilhelm, as the Germans say our names Frederick and William. A long pause will be made before the grand Column of

Victory, 200 feet high—nearly as high as our own Bunker Hill monument at Charlestown, Massachusetts. This column commemorates the great events that made the empire, from the Danish War to the return of the troops from Paris.

THE GREAT MONUMENT OF VICTORY WHICH WAS LOST AND FOUND AGAIN

The statues, set up by the nation, of the Emperor William I. and his first Chancellor, Bismarck, make a great impression on us. They are so fine and so large. We pause, too, beside the statues of the generals, the men of science, and, above all, the world-famed writers, such as Goethe and Schiller, whose beautiful thoughts are a bond of union not only for all Germans, but for all human beings who can read and understand them.

The teacher in charge of such a class as we are supposed to have joined stops to point out the iron cross below the eagle in the copper group over the Brandenburg Gate. That group of Victory in a four-horse chariot was taken bodily away to Paris in 1807, when Napoleon crushed Prussia so bitterly. It was restored seven years later, when the yoke was shaken off, and it was then that the iron cross was added. Passing on by the wide Unter den Linden, the Fredericks and Williams are all eager to relate their grandfathers' stories of the demonstrations they joined in, when victory followed victory, and there were bands and flags, shoutings and hurrahs, ay, and tears, too, for those who never returned. A favourite story is that of the boy who climbed up to the top of the statue of Frederick the Great, to put a crowning wreath on his head, when the news from Sedan sent Berlin wild with joy. The police objected, but the Queen Augusta, watching from the palace windows, sent for the lad, and gave him a present.

THE BOY WHO BECAME EMPEROR AND WENT ON BUILDING THE EMPIRE

Another boy shared in the greatness and excitement of those times in a very personal way, for he was the grandson of the Empress-Queen Augusta and William I. He had already seen the enthusiastic return from the war of seven days when he was about seven, and he now joined in the welcome to his grandfather, recently hailed as emperor at Versailles, to his gallant father, the Crown Prince, and to all the others, back from the Rhine and beyond.

That boy has been German Emperor himself for twenty years now. His face looks at us from the shop windows of the whole of Germany; from the walls of almost every hotel, every school, and every home that we enter. His name, the Kaiser, is on everyone's lips, as he carries on the work of his forefathers, not only in beautifying the capital, but in building up, in his own strong, masterful way, the fortunes of his wide and powerful empire.

People who have always looked upon a sovereign as a sort of automatic figure, only working and acting through others, cannot understand this impetuous, clever man, who from the beginning of his reign has come out of the stiff retirement hitherto thought necessary for a ruler, and put aside the reserve which would prevent his speaking his mind, not only to his Ministers, but to his people. Bismarck himself, the grandfather's old friend and helper, could not see his way to new plans of work, nor had he any sympathy with the many-sided activities and the living personal touch with affairs displayed by the grandson.

HOW THE YOUNG RULER DROPPED THE OLD PILOT AND TOOK THE HELM HIMSELF

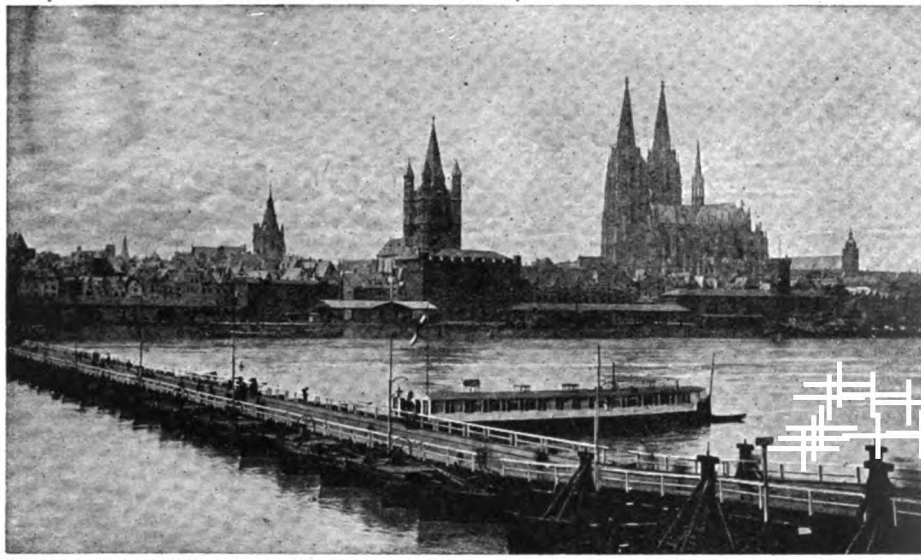
Even the old pilot, therefore, had to be dropped, and the ship of state ever since has had the guiding hand of the emperor himself at the helm, though the great progress in his reign has been on the lines laid down in the old chart.

William II. spends part of the year at Potsdam, about eighteen miles from Berlin, a city of beautiful palaces and parks, often called the cradle of the Prussian Army, because it was here that Frederick the Great did so much to bring it into discipline and order. The Kaiser has never rested till he has made Germany powerful, with armies ready and perfect, able to put out the flames of war, if unhappily any should burst out on her borders. Nothing is too small for him to attend to when the well-being of the Army is in question—the boots they wear, the bicycles they use, as well as the guns and powder.

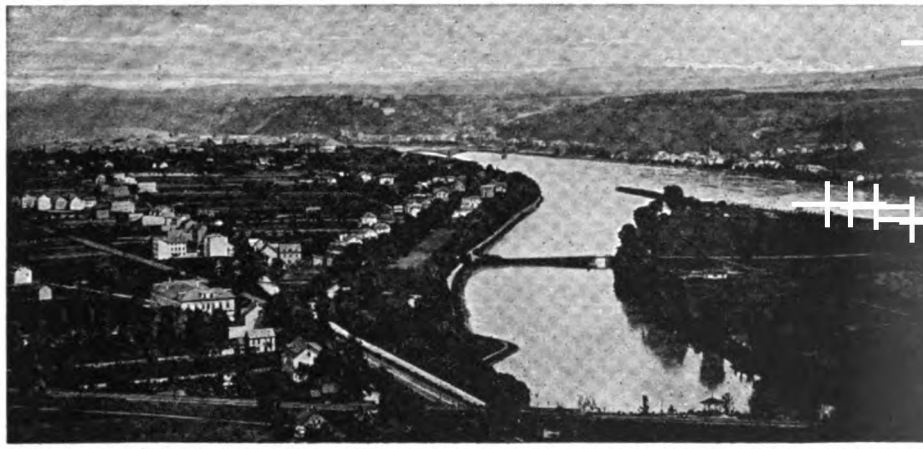
Every German, when he is twenty, has to enter the Army and serve for a year or more, unless some good reason prevents; so the whole nation are soldiers, ready

FINE OLD CITIES OF NEW GERMANY

Dresden, the capital of Saxony, is one of the most beautiful cities of Germany, and has been called "the Germar Florence." It is a great centre of education and music, and its museum is one of the finest modern buildings ir Europe. "Dresden china" was first made, not at Dresden, but at Meissen, a town some distance away.



The ancient city of Cologne dates back to times before the Romans. Its fine cathedral, seen in this picture, was begun in 1248, and only completed in 1880, after ten million dollars had been spent upon it. Cologne is joined to one of its suburbs across the Rhine by a curious bridge of boats, which may also be seen in this picture.



Coblentz, one of the principal fortress towns of Germany, is built where the Rhine and the Moselle join, and i gets its name from that fact, the Romans having called it Confluentes, which means "flowing together." Like Cologne, Coblentz also has its bridge of boats. The fine old archbishop's palace is now used as a factory

and trained to defend their fatherland. At the time of year when the recruits join, the trains are full of them going to the different stations all over Germany, or you meet them marching along the roads singing patriotic songs, such as the "Watch on the Rhine," "What is the German Fatherland?" to splendid, stirring tunes. No doubt it is good for many of them to be drilled and made orderly, but some feel it a great interruption to study and examinations, and others are badly needed in factories and to till the fields.

THE RAPID BUILDING UP OF GREAT ARMIES AND NAVIES

Again, it costs so much to keep up the Army that millions have to be raised in taxes to pay for it. It is sad, indeed, to think of the vast sums spent on guns and battleships and armies, not only in Germany, but in the countries that feel obliged to keep pace with her. So long as men keep to the old barbarous idea of settling disputes about boundaries, or trade, or insults, by sending thousands of men to kill thousands of their fellows, every country is afraid to have fewer thousands ready to send to kill and be killed than its neighbour.

William II. is often called the creator of the German Navy, so rapid has been its rise in his times. Many who went before him saw how necessary it was that the sea-board on the north should be protected, as well as the trading ships on the high seas. But real progress in this direction has only been made in late years, when battleship after battleship has been built and men have been trained to serve in them. Now the German Navy is large and strong enough, not only to defend its own shores, but to uphold the honour of the flag in distant parts of the world.

THE YARDS WHERE THE GREAT SHIPS ARE MADE, AND THE WONDERS OF HAMBURG

"If we have need of ships," said the Kaiser, "we must depend on ourselves," and so great shipbuilding yards have arisen along the sandy shores of the Baltic and North Seas, at the mouths of rivers where the water is deepest. At Stettin, on the Oder, at Danzig, on the Vistula, at Hamburg, on the Elbe, at Bremen, on the Weser, monster battleships and great liners, among the fastest in the world, take shape and start their journeys as we have seen in the shipyards on the Clyde and the Tyne. The headquarters of the Navy are at Kiel; Wilhelmshaven is also a large naval port. These two are at the Baltic and North Sea ends of the great canal which now joins them.

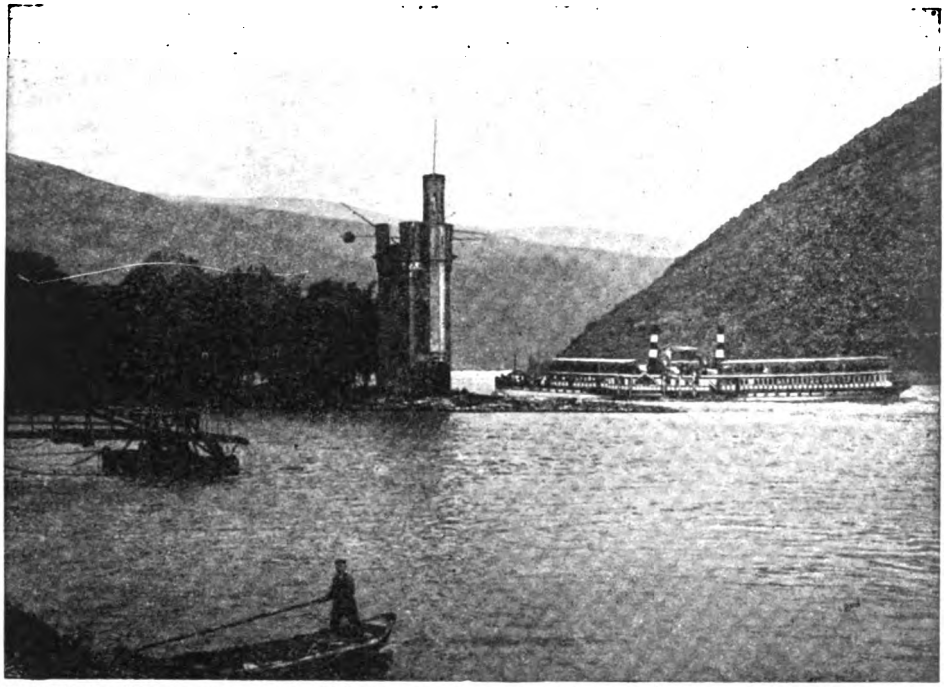
When Bismarck passionately urged the necessity for this canal, so that ships might have a quicker way of getting out of the Baltic than by the narrow passages by Denmark and Sweden, his burning words opened up a new view of what the Navy might be to Germany, and, indeed, of what it is already.

Some of the Atlantic liners—ocean greyhounds, as they are called—start from Hamburg and Bremen; both belonged to the old league of free cities. A steamer trip on the Elbe and in the port gives us the best idea of the wonders of Hamburg, one of the most important places for trade in the world, connected by railways with every part of Europe. Here emigrants embark for the United States and Canada, as well as for England, and ships belonging to every nation jostle each other in the busy harbour, bringing the largest proportion of all that Germany needs, and taking away what she has to sell.

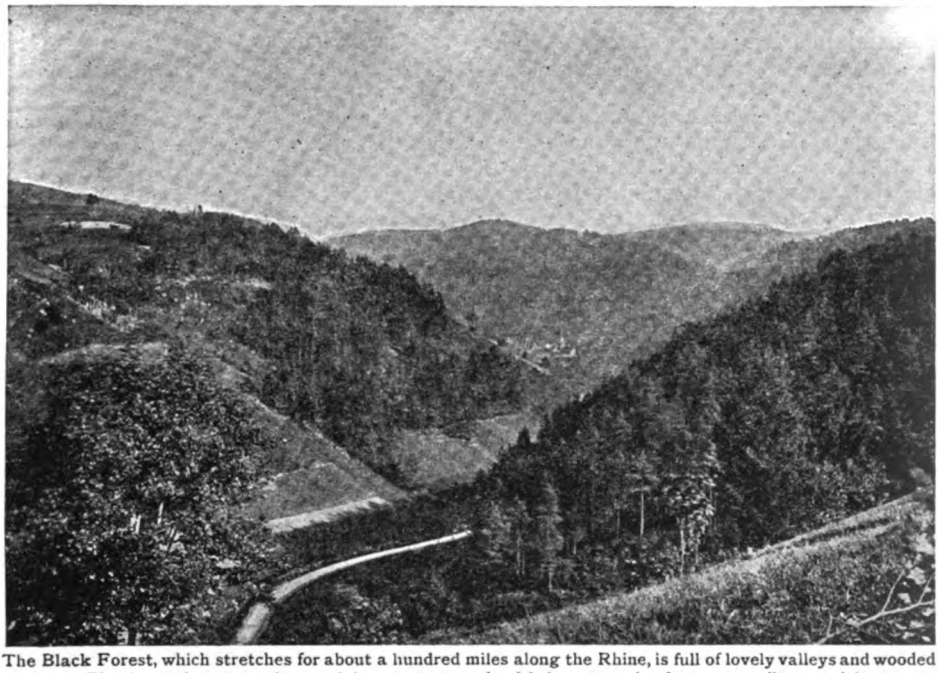
THE BUSY TOWNS AND CITIES ON GERMANY'S GREAT RIVERS

We know what she needs to some extent, from our own imports—tea, coffee, spices, and other things grown in hot climates, as well as raw materials for manufactures. To find out what she has to sell and what she manufactures, let us now travel up the rivers and on the lines of railways that run in their valleys and connect all the important centres. The Elbe, with its long, navigable course—right into Bohemia—and its many tributaries, and its system of canals, plays an important part in the trade of the empire. The Spree, on which Berlin stands, is one of its tributaries. On the banks of the Elbe are Dresden and Magdeburg. Dresden, the capital of Saxony, is full of treasures of art, and famous for delicate china works; Magdeburg is in the midst of great fields of beetroot, from which enormous quantities of sugar are made. Other industries are iron-founding and machine-making. One of the early Holy Roman emperors gave this town, a thousand years ago, as a present to his English bride.

A FAMOUS RIVER AND A FAMOUS FOREST



The "lordly, lovely Rhine, about which so many poets have sung so often, is one of the playgrounds of Europe. A favourite spot is Bingen, "fair Bingen on the Rhine," with its mouse tower, shown in this picture. It is here that the wicked Bishop Hatto is said to have met his fate, as told in the poem on page 2005 of this book.



The Black Forest, which stretches for about a hundred miles along the Rhine, is full of lovely valleys and wooded heights. The forest has many busy mining centres, and, with its network of narrow valleys and its countless trees forming a barrier to the passage of an army, it is part of the great scheme of defence of the German Empire. This picture shows the lovely village of Nussbach nestling among the trees and hills.

The photographs on these pages are by the Photochrome Co., Voigt, Frith, Beckett, E. N. A., and others.

The River Oder runs a similar course to the Elbe, through fields of beet and potatoes or flax, and grain of different kinds. It also connects with Berlin by canal, so that the capital may be said to have two ports—Stettin, on the Oder, and Hamburg, on the Elbe. We have already seen how wonderfully Berlin has grown in its handsome west-end quarters. Its development in the matter of trade and factories is no less surprising. Thousands of workmen make in it machinery and locomotives, arms, chemicals, all sorts of woven goods, and every possible thing needed in furnishing a house.

Breslau, on the Oder, is the second city in Prussia, the capital of Silesia, taken by Frederick the Great from Maria Theresa. Like Berlin, it manufactures steam-engines and railway carriages, and linen and cotton goods.

These two great northern rivers come from the ring of mountains that have kept Bohemia so shut off through the centuries—the Giant Mountains and the Ore Mountains. Round about the lowest slopes of these mountains lie many coalfields, and mines of iron and zinc, and many other precious and useful metals. Hence the railway lines are thick here, as they are in our busy industrial districts at home.

THE MANUFACTURES THAT HAVE HELPED TO MAKE GERMANY PROSPEROUS

The wool of the sheep of Saxony and Silesia is used in the making of the famous flannels and warm materials now prized all over the world. Formerly Germany was an agricultural country, growing enough corn and roots to feed its people, and raising great numbers of sheep, cattle, and horses. Now its chief wealth lies in its great manufacturing powers; and its energy and ability in this direction are the wonder of the world. We have just glanced at some of the industries in the valleys of the northern rivers; passing westwards there is Leipzig, the seat of the book trade, and Jena, where lenses for telescopes and microscopes are made for the whole world. We shall find cotton and silk factories in the north-west of the country, where it is easy to obtain the raw material from abroad, and coal from the neighbouring coalfields. One of the largest of these is in the Ruhr Valley, near the Rhine, and upon it depend the enormous iron and steel works which supply most of the plates of iron and steel, the boilers and engines, and thousands of things needed to build up a great liner or warship, as well as cannon and arms of all kinds needed by the Army and Navy.

THE CATHEDRALS AND FACTORIES ON THE BANKS OF THE RHINE

In Krupp's great factory at Essen alone there are thirty thousand people at work, and for miles round are growing towns, with tall, smoking chimneys, and the roaring blast furnaces and deafening clang of metal-working, reminding us of the Pittsburg region at home. The largest inland port in Europe is formed of three towns at the point where the Ruhr joins the Rhine, and here are docks and shipbuilding yards, besides business centres for grain and timber. Everywhere, too, in this district are factories in which furniture of every kind is made.

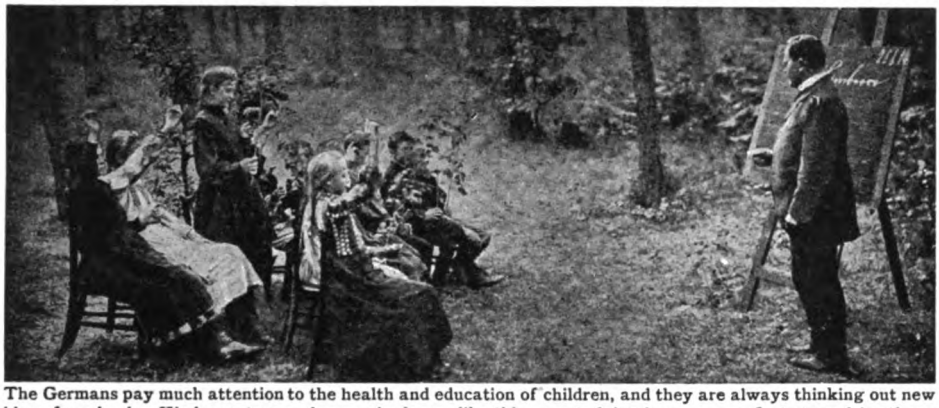
There are many passenger steamers on the Rhine; one runs from the mouth, in Holland, as far as Mainz, and provides an easy and pleasant way to see this wonderful part of Germany. After passing the flat part of the course, where the interest of the busy work going on makes up for the dulness of the scenery, we reach Köln—better known to us by its French name of Cologne—famed for its cathedral, one of the most magnificent Gothic buildings in the world. It was over six hundred years in building, and, when finished at last on the old plans, was opened in the presence of the Emperor William I. and the sovereigns of Germany.

Not far from Köln is Aachen, called by the French Aix-la-Chapelle, the home of Charlemagne, and there we can still see in the interesting cathedral a gilded candlestick presented by Barbarossa.

THE TOWNS OF THE RHINE AND THE MOUNTAINS OF THE FAIRIES

The hills begin to rise each side of the broad river after leaving Cologne, and we pass numbers of towns and villages with promenades shaded by avenues of stumpy trees close to the river. The most important towns are Bonn, with its fine university and the romantic seven mountains close by, so full of legends and fairy stories; and Coblentz, beautifully situated where the Moselle joins the Rhine. On the terraced slopes

THE OPEN-AIR LIFE OF GERMAN CHILDREN



The Germans pay much attention to the health and education of children, and they are always thinking out new ideas for schools. Kindergartens and open-air classes like this one studying botany were first started by them.

All German children are taught that it is important to live as much as possible in the open air, and here we see a German mother with her children and their nurse taking their midday meal together in the garden of their house.

This is a familiar street scene in many German towns, and we can see how the children look as they go to, or come from, their schools. The tradesmen's carts are drawn about many of the cities by big dogs.

of both rivers grow the vines from which much famous wine is made, and this trade makes Coblentz and other towns very busy.

On the Moselle is the oldest town in Germany, Trier, which the French call Trèves, with its beautiful Roman bridge and gate, and fine remains of theatre, baths, and temple. Here, too, is a most interesting brick building, built in the century before the Angles went to England, called the Basilica, where justice was administered. Now it is used as a Protestant church.

THE FIGURE OF GERMANIA KEEPING WATCH ON THE RHINE

From Coblentz to Maintz the scenery is very beautiful, with hills rising steeply from each side, many of them crowned with castles famous in the country's story in the Middle Ages; and everywhere grows the vine, and everywhere, too, are traces of the Romans and the French, who have both occupied it in the past.

A few years after the Franco-German War, which gave Alsace-Lorraine to Germany as an Imperial territory, an immense national monument was set up on the hills opposite Bingen. It is the figure of Germania keeping watch on the Rhine. It is thirty-four feet high, and bears aloft the Imperial crown and the laurel-wreathed sword. On the huge base are portraits of the Emperor William I. and other German princes and generals, also representations of the troops from different states of the empire, together with the words of the famous national song, "Die Wacht am Rhein"—"The Watch on the Rhine."

SOME FAMOUS TOWNS, A FAMOUS SHOEMAKER'S SHOP, AND A FAMOUS FOREST

Maintz—in French, Mayence—has a fine position at the meeting of two rivers, and has a long and interesting history. Its museum is very famous for its rich collection of Roman remains. Among other treasures is the Roman shoemaker's workshop, all complete with tools, leather and sandals. Shoes are still made at Mainz, but, like Coblentz, it is a great centre for the wine trade.

Strassburg, the capital of Alsace-Lorraine, is two miles from the Rhine, but connected with it by canals and the River Ill. It is a sort of junction between Germany and the trading and manufacturing places just over the borders in France and Switzerland, and has always been a busy and important place. Its history has been an eventful one, which has left many traces in its fine cathedral and public and private buildings. The Vosges Mountains are the western boundary of this upper part of the Rhine, and in its valleys are many ironworks, and weaving and other industries. Mülhausen is the most important manufacturing town in the province, with its iron foundries and engineering works. It also employs many people making cotton goods, chemicals, and paper. It is on the canal joining the Rhine and the Rhône basins.

East of the Rhine, in Baden, lies the beautiful Black Forest. Here the peasants in their quaint little houses carve wood figures very cleverly, and also great numbers of cuckoo clocks. There are also many mines in the mountains, and industries of various kinds. Many visitors go to Baden to drink the mineral waters. The plain of Baden is very fertile.

THE MIGHTY RIVER RISING IN THE FOREST, AND THE TOWNS ON ITS BANKS

From the Black Forest rises the mighty Danube; the upper part of its course lies in Würtemberg, a hilly agricultural country about the same size as Wales. At Ulm the Danube passes into the large kingdom of Bavaria, and upon it, or its tributaries, are many great cities.

There is Munich, the capital of Bavaria, on the Isar, the third largest city in the empire, which attracts the art-loving world to see its treasures of pictures and its museum collections, and also to hear its beautiful concerts.

Augsburg possesses abundant water power, obtained from canals crossing the town, which has given rise to industries such as weaving and cotton-spinning, and making machinery. In the past it was a centre of traffic from the north of Europe to Italy and the eastern part of the Mediterranean; and its buildings, lasting till to-day, remind us of the rich citizens of the Middle Ages, and the money-lenders who helped such great sovereigns as Maximilian I. and Charles V.

There is much that is interesting to be seen at Ratisbon, often called the key of the Danube, from its position; and fighting has often raged round

it, from the times of the Romans right down to those of Napoleon Bonaparte.

Ludwig I., King of Bavaria, built, in the last century, a German temple of fame a few miles out of Ratisbon. It is built after the copy of the most beautiful of the Greek temples, the Parthenon at Athens, of grey marble. Over the north entrance is sculptured a representation of the battle won by Hermann over the Romans; on the south side, facing the Danube, is shown Germany regaining her liberty after the battle of Leipzig. Inside, running round the entire hall, is a frieze showing the history and life of the Germanic race before they were Christians. Over a hundred busts represent famous Germans who have helped to make history. William I., the Victorious, was added in 1898. There are also tablets bearing the names of great men of whom no portrait exists, and some commemorate the work of those whose names, even, are unknown, such as the writer of the greatest early German poem and the architect of Cologne Cathedral.

THE TOWN THAT SENDS CHILDREN'S TOYS ALL OVER THE WORLD

Not far from Ratisbon is Nüremberg, a free city of the empire till 1806, since when it has belonged to Bavaria. Long ago it was a centre of trade between Germany, Venice, and the East, and then the discovery of the sea route to India, round the Cape, took away much of its commerce and prosperity. It has very interesting old houses, like so many of these South German towns, and is full of reminders of the long wars, as well as of the wealth, importance and taste of a "City of the Empire." It is famous now for the great numbers of toys that pass from its workshops to delight children everywhere; also it makes machinery and metal wares, and lead pencils. We are nearing again the Ore Mountains, whence we set out on our tour to the various cities of Germany. In nearly all these cities are fine old cathedrals, picturesque market-places and town halls, also universities, often dating back to the far past. And everywhere are statues and war memorials, as in Berlin, linking the past with the present.

What numbers of different sorts of people we have passed on our road! Peasants in different states wear different costumes; and manners and customs and speech vary as much as they do in different parts of England and Scotland. Germany is nearly four and a half times the size of New York State, but there are more than sixty millions of people living in it.

THE PEOPLE OF GERMANY AND THEIR RELIGION

More than half that number of people live in Prussia. Many work in the fields and vineyards and beautifully-kept forests, which cover a quarter of the country, in rain and shine. Others are to be found in the mines and factories, yards and shops, in the ports and ships, in the army, in the schools and universities.

We have heard the gay Rhinelanders singing the glories of the Fatherland and the beauties of the country, as the soldiers marched, as the schoolgirls played in the woods, as the students tramped up and down the hills. In other parts of the country the people are graver or slower, according to the branch of the German family to which they belong. Some of the differences that have arisen in the past have been on account of religion. North Germany is chiefly Protestant; South Germany is mainly Roman Catholic. In the Rhineland are numbers professing both faiths. Slowly jealousies and dislikes are passing away under the influence of common aims and interests, and increased facilities for travelling about and mixing with each other, and the rise of better education.

THE SPLENDID SCHOOLS TO WHICH THE GERMAN CHILDREN GO

Germany has always been in the forefront in matters of education, and to-day—except in the districts where so many poor Polish Jews live, on the borders of Russia—there are very few people unable to read and write. It was from Germany we learnt how to make first lessons interesting to little children in kindergartens, and great pains are taken not only in elementary schools, but in higher grades, to make learning useful and attractive. The fees in the higher schools are so low that even poor people can send their children, and as it is much cheaper to attend the universities than it is with us, and there are so many of them, almost any student can take advantage of the highest education to

be had. Then great attention is paid to teaching the various trades under the best possible conditions, so that workers get a thorough training to fit them to earn their living. The Government has done its best to get the most useful subjects taught in schools, so that time should not be wasted, and to spread the knowledge of trades and industries, so as to encourage skilled workmen all over the empire. Before the Kaiser came to the throne, Germany had been very slow in extending her borders beyond the seas and finding new markets for the goods she manufactured. At first travellers visited foreign parts, and traders from the old free cities followed them, setting up factories on the west and east coasts of Africa in places yet empty and ungoverned. A telegram from Bismarck, directing the German flag to be hoisted in certain of these places, thus taking the merchants under the empire's protection, was the beginning of German colonies. Later, large territories in various parts of Africa have fallen to Germany. She has fought the cruel slave trade of the Arabs, and is spreading railways and civilisation over inland districts whose snow-topped mountains, magnificent lakes and waterfalls, are among the wonders of the world.

Germany also holds some of the beautiful Samoan islands in the Pacific, and Bismarck Archipelago off the north part of New Guinea, as well as a small territory in China, likely to become of great use. Every possible means is taken to teach the country about these distant possessions by holding colonial exhibitions, showing maps and samples and photographs, and giving all information that will encourage people to go out and settle. Information, too, about the need for a large Navy to protect merchant ships and colonies is freely given, so that, when the people have to pay heavy taxes, as they do, they may understand how they are spent. For the German citizen grumbles about his taxes just as your father does, and in many other ways is like his relations of the same old Teutonic stock in England and America. All are proud of their magnificent navies, of their immense industries and trade, of the happy home life of their people. Those who sing with such fervour "My country, 'tis of thee," should be able to appreciate and enter into the German's grand love of country as the musical voices roll out in chorus: "Was ist des Deutschen Vaterland?"

DROPPING THE PILOT

This, the most famous of all Sir John Tenniel's "Punch" cartoons, shows Prince Bismarck, the old pilot who had guided the German ship of state into the harbour of prosperity, passing from the direction of affairs, while the new captain, the young Emperor William, who dismissed him, looks down from the deck.

What is the German Fatherland?
Is it Prussia, is it Swabia?
Is it Rhineland, or Bavaria?
Is it where the sands of the North Sea roll?
Is it where the Danube surges and foams?
Greater far is the German Fatherland!

This is the song, full of inspiration and the music of patriotism, that is sung to-day all over the great German Empire.

The next story of Countries is on 2851.

THE STORIES OF CHARLES DICKENS

TWO more of the famous Dickens novels are told here in the form of short stories. "The Old Curiosity Shop" has not so strong a "story" interest as "Barnaby Rudge." In the first named we are deeply interested in the many strange characters to whom the author introduces us, but in "Barnaby Rudge," while the characters also interest us greatly, the story itself is one that can "hold children from play and old men from the chimney corner," so strong a grip does it take upon our mind. Of course, it is impossible in our limited space to bring in all the characters that figure in the original novels; but all who play a part in the story, that could not be left out, will be found in the following pages.

THE OLD CURIOSITY SHOP

CONTINUED FROM 2639

THE curiosity shop contained many quaint old things—rusty weapons, suits of mail, figures in china, tapestry, and pictures, but nothing in it looked older or more worn than its proprietor. He was a little old man, with long grey hair and bright blue eyes, and he lived here with only his granddaughter Nell Trent, a fair-haired, blue-eyed, sweet-tempered child. But though their years were so far apart, they loved one another dearly, being constant companions, and the old man's one desire was to build up a fortune for the child, that she might some day become a "fine lady." They had an errand boy, awkward and shock-headed, whose name was shortened by everyone from Christopher Nubbles to "Kit." And every night, when the old man used to go out on some mysterious errand, coming back in the early morning, he did not know that the faithful Kit had been watching over the house in which slept the lonely child, so that no harm should come to her.

Now, although Nell and her grandfather seemed to be all alone in the world, they had one relation, and that a very near one, no more distant, in fact, than Nell's brother Frederick. He was a selfish, spendthrift young man, always anxious to obtain money from the grandfather, and often reproaching him as a miser. If he had only known the cause of the old man's poverty! The secret of the nightly journeys was simply this: the old man tottered out to gamble with every penny he could get, in order to win more money for little Nell. Alas, to do this he had been obliged to borrow from Mr. Quilp, a misshapen dwarf, whose delight in life it was to make other people miserable.

When Quilp guessed how the old man spent his nights he boldly questioned him about the matter, and, instead of lending him the money for which he was asked, he had the goods in the shop sold off to redeem the debt already owing. Quilp falsely told him that Kit had been his informant, and thus the old man grew very angry with the clumsy boy, and spoke of him so harshly that Nell had to forbid Kit the house. Even when Kit asked her to make her home with his hard-working widowed mother, now that she and her grandfather had no money, the child dared not do so. Quilp's anger had been roused against Kit when the boy had said that he was "an uglier dwarf than could be seen anywhere for a penny," which, by the way, was undeniably true, but none the pleasanter for that.

There was nothing now for the grandfather and Nell to do but to leave the Old Curiosity Shop, and so they fled one night, wandering until they came into the country. Kit took home with him Nell's little caged linnet, and he soon obtained a good post as groom to a kind, rosy-cheeked, chubby old man named Garland. As the wanderers rested in a country churchyard they heard the sound of voices near at hand, and when they went down a path they

saw two men repairing a Punch and Judy show. They made friends with the men, stayed at the same inn overnight, and travelled with them the next day. But it was not long before Nell began to grow afraid of these men, who had got it into their heads that the old man and his granddaughter had run away from well-to-do friends, and that they were certain to gain a reward if they could restore them. So the child, who had now the cares of a grown woman on her shoulders, and the arranging of all the plans for the future for her aged companion as well as for herself, again planned their escape, this time while the men were exhibiting their show at a fair.

Nell encouraging the old man, they continued their wanderings. When quite exhausted they obtained shelter from a lonely schoolmaster, and, after after leaving him, from a Mrs. Jarley, who travelled in a caravan with her waxwork show. Mrs. Jarley took a great fancy to the tender-hearted child, and employed her to show the wax figures to the country folk, while she also cared for the grandfather.

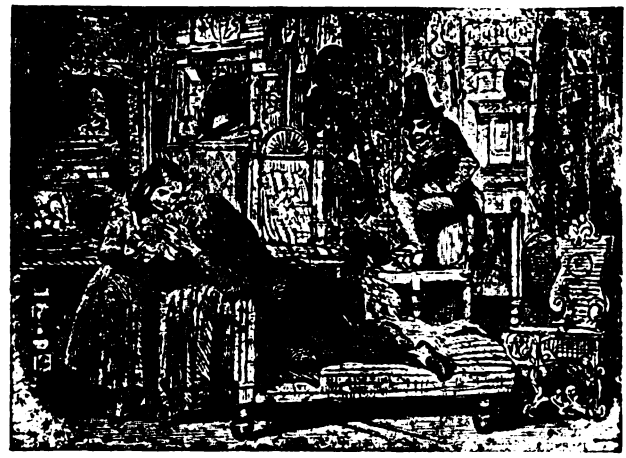
But the old man, who was no longer sane in his overmastering desire to win money to make Nell a "fine lady," took every penny he could from the poor child so that he might gamble with it; and at length Nell found that he was actually intending to steal money from Mrs. Jarley, with which to try his fortune again. The loving heart of his granddaughter could not endure the thought that he should stoop to dishonour, and she persuaded him to leave the hospitable Mrs. Jarley before he was guilty of robbing her.

Now, Quilp had a friend, just such a friend as one might expect the wicked dwarf to have—an attorney named Sampson Brass. Between the two, many people had come to grief, and many wrongs had been done to innocent persons. For reasons of his own, Quilp had obtained the post of clerk in Sampson Brass's office for Richard Swiveller, better known as "Dick," who was a friend of Frederick Trent. Dick was a warm-hearted, careless youth, always in debt, and when not quite sober he was apt to let out secrets. That he had a great many debts we may know from the fact that there were certain streets in London down

LITTLE NELL AND HER GRANDFATHER IN THE OLD CURIOSITY SHOP

which he dared not walk for fear of his creditors, and he was afraid that he would soon be obliged to seek his fortunes elsewhere, as he made street after street a closed thoroughfare.

Mr. Brass had a lodger, a single gentleman of eccentric habits, who seemed to do little else than sleep both night and day, unless a Punch and Judy show came near. Then, indeed, he wakened up, made the showmen come to his room, talked earnestly with them, gave them something to drink, and sent them away again. The little maid-of-all-work was an ignorant, shy, nameless creature whom Miss Sally Brass ill-used and half starved. Dick, however, made friends with her, being sorry for her loneliness and being lonely himself. He taught her to play cribbage, bought—or, rather, incurred the debt of—food for her, and dubbed her "the Marchioness."



LITTLE NELL COMFORTS HER GRANDFATHER

It often happens that those who are the poorest are most willing to share the little they have. Nell found it so now, for she received many kindnesses from the humble folk who took pity on her. Footsore and weary, she and her grandfather lay down to sleep near a river. They were roused by two men who were drawn in their boat by a horse, and were helped by them upon their journey. Tired and cold, an uncouth man led them to his furnace fires and made them rest there overnight. But once more someone was to be of use to them; this time their kindly old friend, the schoolmaster. He had received a better appointment in a distant town, and his surprise and joy were great when he met his two travellers on the way. Together they walked and talked until they reached his new home, and there he found for Nell the rest she so sorely needed. It happened that the old woman who formerly had the care of the church, opening and closing it at service times, and the showing of it to visitors, had recently died; the work was light, and suited for the delicate child. The schoolmaster obtained it for her, and she and her grandfather settled down in the place. Thus at last they found peace and contentment, beloved by all, and happy in their mutual love. They were to spend many peaceful days in the beautiful, smiling country.

MRS. JARLEY AND NELL IN THE WAXWORK SHOW

Meanwhile, Quilp decided to ruin Kit altogether, and he concocted a plan with his friend Sampson Brass. Both Sally Brass and her brother declared to Dick that of late they had missed several half-crowns and a silver

pencil, but they knew of nobody who could have taken them. One day Kit came to the office, and a five-pound note had been laid down carelessly as a trap for him. He had gone but a little way, on leaving the office, when he was ordered to come back, and, being certain of his innocence, the boy consented willingly to having his pockets searched. He became quite relieved when there was discovered in them nothing of any importance, but he was much amazed when the five-pound note was found in the lining of his hat. Of course, he was tried and sent to prison. Who could believe, after such evidence against him, that he was not guilty? Shortly after this Brass paid Dick his salary and dismissed him.

HOW "THE MARCHIONESS" REPAID DICK SWIVELLER'S KINDNESS

Dick Swiveller had a bedroom in a house close by Sampson Brass's office, and there, within twenty-four hours of his dismissal, this foolish young man was paying the penalty of his drinking habits, for he lay on his bed stricken with a raging fever.

In about three weeks' time he recovered consciousness, but he imagined himself still to be dreaming when he saw, close by, "the Marchioness" playing cribbage by herself. She explained to him that she had run away from Sally Brass, and had nursed him through his illness. Dick asked what had happened to Kit, and the small servant told him that also; but she knew more about it than most people, for she had listened at the keyhole of the office door, and had overheard a conversation between Sally and Sampson Brass, from which she gathered that Brass was to put the five-pound note in Kit's hat, have him sent to prison, and he would thus pay Quilp's grudge against the boy. Dick was, of course, too weak to rise from bed, but he wished to do so at once that he might proclaim abroad Kit's innocence.

KIT IS RELEASED AND SAMPSON BRASS IS PUT IN PRISON

Luckily, however, in one way, "the Marchioness" had been obliged to sell his clothes to get some money for him when he was ill. This did not prevent Dick from sending her at once for Mr. Garland. Kit's employer came in great haste, and showed much kindness to the invalid, and of course Kit was soon released; but though Sampson Brass was imprisoned, his sister managed to escape. It so happened that the lawyer who had aided Mr. Garland in the punishment of Sampson made inquiries about Dick, and found out that an aunt of his had died, leaving him with an income of $750 a year. In his gratitude towards her, Dick sent "the Marchioness" to school now that he had some means of his own; and when she left, now grown into a bright, clever young woman, she married the man whom she had nursed so tenderly.

Quilp was warned by Sally Brass that he would be arrested if he did not escape quickly. On a dark, murky night he tried to make his way along the wharf as the officers came to arrest him, but he staggered and fell, and next moment was fighting with the cold, dark water. His body was found some days later, and it was buried with a stake through the heart at a lonely cross-roads, that being the old way of burying people who had committed suicide, though Quilp's death was an accident.

WHO THE MYSTERIOUS "SINGLE GENTLEMAN" WAS, AND WHAT HE DID

The lodger at Sampson Brass's had now gained a clue to a certain mystery, thanks to his inquiries of the Punch and Judy men, and he at once went forth on a search for Nell and her grandfather. He told Mr. Garland that he and the grandfather were brothers. When they were both young he was very delicate, the grandfather being the elder and stronger of the two. Both fell in love with the same beautiful girl, but the younger one remembered how kind his brother had always been to him, and he left his home to travel abroad, so that he should not stand in his brother's way. The two young people had married, and one daughter was born to them before the mother died. This child, when grown up, had married a handsome young man, who had treated her badly. Both she and her husband died young, and left the old man with two grandchildren to look after—Nell and Frederick Trent. The girl had become sweet and beautiful like the mother, the boy a worthless fellow like his father.

Kit and Mr. Garland went with the single gentleman—who was really

Master Humphrey, the teller of the whole story—to find little Nell and her grandfather in the village where their life was now being passed so peacefully. When at length they got to the house, Kit was the first to enter the room in which the old man sat looking into the fire—but he sat alone. In an inner room Nell lay sleeping, he told them, and after a long time they followed him to her room. Her sleep was indeed a long one, for she was dead. "Dear, gentle, patient, noble Nell was dead. Her little bird—a poor, slight thing the pressure of a finger would have crushed—was stirring nimbly in its cage, and the strong heart of its child-mistress was mute and motionless for ever." Not long afterwards the old man followed her to the grave, and so ends the story that began in the Old Curiosity Shop.

THE COMPANY IN THE MAYPOLE INN ONE STORMY NIGHT OF MARCH, 1775

THE STORY OF BARNABY RUDGE

In the comfortable Maypole Inn, on the border of Epping Forest, there was assembled round the fire one stormy night of March, in the year 1775, an oddly-assorted group of men, drinking and smoking. Of the company only one was a stranger. He was a weather-beaten fellow with a rough, grizzly beard, and an ugly wound on his face. After a while this stranger asked the company about a house which was within a mile of the Maypole, and thereupon old Solomon Daisy, the parish clerk and bellringer, told the story of the Warren, as the house was named, and here it is.

Twenty-two years before it had been the property of a Mr. Reuben Haredale, a very rich man. His wife died and left him with a daughter scarcely a year old, and, feeling lonely, he went to London for several months. On his return he brought back with him two women-servants, a steward of the name of Rudge, and a gardener. The bellringer of Chigwell, a village near by, had been alarmed that very night by the sound of a bell, just as he was about to toll the church bell for an old man who had died that day. In the morning it was found that Mr. Reuben Haredale had been murdered in his bed, and in his hand he held part of a rope connected with an alarm bell which rang on the roof of the Warren. His gardener had disappeared, and months afterwards the supposed body of the steward, Rudge, was found in a pool in the grounds,

scarcely recognisable save for his clothes, ring, and watch. A large sum of money had been taken, and people naturally believed that the gardener

SIR JOHN CHESTER AT HIS EASE

had committed the double murder in order to steal his employer's money. The Warren was now tenanted by Mr. Geoffrey Haredale, brother of the deceased man, who watched with jealous care over his niece, Emma Haredale, the child who had been born there, now a beautiful young woman.

When the sullen and mysterious stranger had heard this story, he immediately set out for London on horseback, giving Joe Willet, the son of the Maypole landlord, a savage cut with his whip as he rode away. When well on his journey he picked a quarrel with a travelling locksmith, named Gabriel Varden, with whose vehicle his horse had collided in the dark. Gabriel, after this encounter, went on to the Maypole, where he was well known, and had some gossip there about the strange man before he resumed his journey to London. He could see the city becoming visible as dawn approached, when he was startled by a cry for help hard by. On the ground there lay young Edward Chester, Miss Haredale's lover, and round him circled a crazy boy, none other than Barnaby Rudge, the son of the dead steward of the Warren. Gabriel and he conveyed the young man to Mrs. Rudge's little house, and with careful nursing he was soon restored to life and health. When Gabriel went back the next day to inquire for Mr. Chester, he was talking to the widow just as someone knocked at the window. Mrs. Rudge went to the door, and in a moment Gabriel heard her call out in horror and surprise. The locksmith rushed to her aid, and was surprised to see the stranger he had met the preceding night. He would have caught him, but the widow clung to him until the man escaped. She explained that this man held other lives than his own in his power, and between them there existed a secret which she dared not breathe. Later on Mrs. Rudge went to Mr. Haredale, telling him she must leave her house to become a wanderer, and refusing to touch again any of the money he allowed her every year.

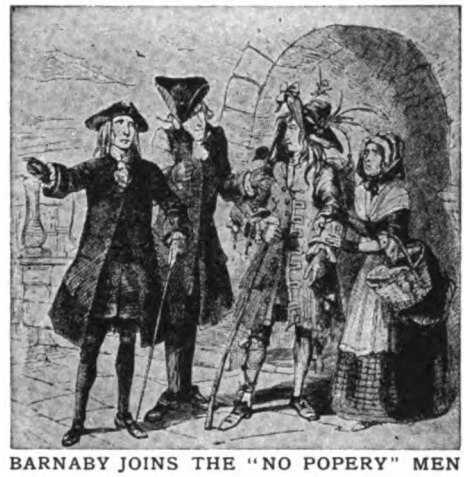
Now, Edward Chester's father, Sir John Chester, was the bitter enemy of Geoffrey Haredale, having even hinted that Mr. Haredale was his own brother's murderer, and in a strange interview which they had at the Maypole one night each agreed that he would do his best to keep the lovers apart; Sir John was to restrain his son, and Mr. Haredale to reason with his niece. Sir John next told Emma that his son was not true to her, which she refused to believe, and afterwards he told Edward that he was to give up Emma, as he must marry an heiress, because they were already greatly in debt. The young man hotly resented this, and his hypocritical father at once disowned him, and Edward went to the West Indies to seek his fortune. At the time that the father cast off his son, Joe Willet did the opposite, and left his father. He could no longer endure being treated as a boy, and after bidding

DOLLY VARDEN TAKES EDWARD'S LETTER TO EMMA

farewell to Dolly Varden, the locksmith's charming daughter, he enlisted in a regiment about to go abroad. Dolly became the companion of Miss Haredale when both their lovers had left England.

Five years passed away. The landlord of the Maypole Inn had been told by the bellringer that he had seen the ghost of a murdered man appear to him on the anniversary of the very night on which Mr. Reuben Haredale had been killed, and honest John Willet thought he ought to let Mr. Geoffrey Haredale know of this. He went to the Warren with his news, accompanied by Hugh, his ostler, a rough fellow, but handsome after a wild gipsy fashion, and of great strength As they were returning they were accosted by three horsemen, who asked if they were on the right road to London. When they knew that it was thirteen miles away, they next asked if there were any inn near, and ended by following John and Hugh to the Maypole. These men were Lord George Gordon, his secretary, and his servant. Lord George was a strong Protestant, and when, in 1780, some laws were proposed to improve the position of the Roman Catholics in England, he determined to contest these laws at all costs.

He roused up the people with his fiery speeches, until the cry of "No Popery!" was heard wherever he went. At this time he was waiting until the moment was favourable for raising a rebellion. The men who joined him had been a Roman Catholic, but had changed his religion to suit his own ends, and poor, weak Lord George was little more than a tool in his hands. Ned



BARNABY JOINS THE "NO POPERY" MEN

Dennis, the hangman, was on their side, and the lawless Hugh soon joined them. By tempting witless Barnaby with their badge, a blue cockade, they won over that crazy young man, who loved finery of any description, and now, wherever they went, Barnaby went also, carrying in a basket his pet raven, Grip, of which he was very fond. This strange bird had a stock of phrases which he produced on all sorts of occasions, and now he added "No Popery!" to his cries of "Polly, put the kettle on, we'll all have tea," "Grip, the wicked," "Bow, wow, wow!" and others.

Lord George Gordon presented a petition to Parliament against the repealing of the Catholic laws, and in Westminster his followers gathered. These men became uproarious after a time, until the Riot Act was read, the horse-soldiers galloped in amongst the crowd, and many of the rioters were taken to Newgate Prison.

Not long afterwards, Hugh led the men out to the Maypole Inn, where they broke everything on which they could lay hands, drank freely of all the spirits, and finally left John Willet, the fat little landlord, tied to his chair, next making their way to the Warren. Hugh was mindful of certain orders Sir John Chester had

VARDEN DRESSING FOR THE VOLUNTEER PARADE

were not always men who cared at all for religion; many of them were merely anxious for a fight, others had different purposes to serve. His own secretary

given him, and the beautiful old house was fired, and soon became a smoking ruin. While John Willet remained fixed to his chair at the Maypole, staring vacantly and wonderingly around, a man came in and asked which way the rioters had gone. This man was none other than the sullen stranger who had been there five years before.

As he was leaving the inn, he stopped at a sudden sound—that of the bell from the Warren. It sounded deep into his heart, and he hastened to the old house, hovering about it like a dreadful bird of prey. Presently Mr. Haredale came upon him and threw himself on the man, clutching his throat with both hands, calling him by the name of Rudge, murderer and monster! And, indeed, it was none other than the faithless steward who had murdered his master and the gardener, dressed the latter up in his own clothes, and escaped. His existence had been the secret the poor widow was obliged to guard, while he extorted money from her, following her wherever she went

POOR BARNABY IN NEWGATE PRISON

In his cell in Newgate Prison, Rudge explained to a former comrade that he had been unable to stay away from the Warren; that the dead man seemed to draw him there as if he were attracted by a magnet. In this prison, too, poor Barnaby, who had been arrested while acting with Lord George's followers, first met his father. After some time the Gordon rioters burned down the building to procure the release of their friends.

Barnaby and his father, escaping, wandered out into the country, but when the murderer Rudge became ill Barnaby went to find Hugh, and was just in time to see him knocked off his horse in the midst of a crowd in Holborn.

Hugh was able, however, to accompany Barnaby to the hiding-place where Rudge was lying, but the next day they were all captured by soldiers, whom Dennis the hangman had told about their escape, when he himself was arrested.

Meanwhile, both Emma Haredale and Dolly Varden had been captured by some of the riot leaders who burned down the Warren and taken to London. Their friends were searching for them far and wide. How delighted they were when they were discovered by Mr. Haredale and Gabriel Varden, the latter of whom had become a sergeant of the London Volunteers at this troublous time. But they were even better pleased to see with them Edward Chester and Joe Willet, even though the latter had come home with only one arm, having lost the other at the defence of the Savannah.

The murderer Rudge, Hugh, and Barnaby, were all condemned to be hanged. Hugh's last wish was that he might save Barnaby, as he was sorry for the poor, half-witted boy. As Barnaby was mounting the scaffold, a reprieve was brought for him, his friends having spent the whole of the previous night in procuring it, and honest Gabriel Varden having tried even to see the king on his behalf.

Lord George Gordon was imprisoned, and died at Newgate in 1793. In a duel Mr. Haredale killed his old enemy, Sir John Chester, and afterwards fled the country, dying in a monastery abroad. Edward Chester married the beautiful Emma, and they sailed to the West Indies, where he had amassed a fortune. Joe Willet married Dolly Varden after all, and when he inherited the Maypole Inn, Mrs. Rudge, with Barnaby and the faithful Grip, came to live with them, and the poor youth's mind grew clearer with advancing years.

The next story of Books is on 2827.

The six Morris dancers in costume performing the "Ring" figure in the Bean Setting Dance

HOW TO DANCE THE MORRIS DANCES

CONTINUED FROM 2694

THE quaint old English Morris Dances, though of Moorish origin and taken into England in the Middle Ages, perhaps from Spain by John of Gaunt, became very popular in that country. The country folk altered them to suit their own ideas of a dance for holidays and feast days, so that from the time of Queen Elizabeth no festival was complete without the merrie Morris men. Just when the dances were in danger of being forgotten, new interest in them arose, and now they are much practised in gymnastic and dancing classes. The old tunes which go with them have also been preserved and adapted to the modern piano. They are in various times, and the step also changes in height and length.

And first, how do the dancers dress, and what do they need? The old Morris men wore very fantastic garments, but girls and boys who dance now can hardly do better than wear the simple rustic ones shown in the pictures—the boys, or girls taking the boys' parts, holland smocks and hats; the girls, cotton frocks and sun-bonnets. All of them wear elastic bands round the leg, on to which four or more bells are sewn. These can be bought at 10 cents a dozen Ribbons may be worn, but the bells are essential to all the dances, and one object of taking the jump is to rattle the bells.

Then sticks will be wanted for some of the dances, plain round wooden sticks about eighteen inches in length. They can be bought in bundles, or made at home from blind-rollers or the sticks for tying up flowers. Each dancer will want two handkerchiefs.

The Morris Dances have a special step and a peculiar jump; one or the other, the step or the jump, is going on throughout the dance. The jump is taken with the body held straight and then raised by springing suddenly with both feet off the ground. The feet land on the ball of the foot, the toes touching before the heels, so that the spine is not jarred. The step is easily imitated when once seen, and the music almost suggests it. In Bean Setting you raise the right foot as you do in taking a walking step, and move it forward so that the heel is about as advanced as a foot length from the toes of the left foot. Then hop twice on the left foot, and repeat the step with the right foot.

One form of the step used in the Laudnum Bunches bears a likeness to the polka step, only danced with stiff knees, hopping on right, on left, on right, and on right again, with left extended in front.

In the high step which belongs to the Capers movement described later on, the toes of the lifted foot are as high as the knee of the other leg. The step matches the music so well that it is difficult not to keep time.

The names of the Morris Dances are as quaint as themselves, and suggest their country origin. The best known are probably Bean Setting, Laudnum Bunches, Rigs o' Marlow, The Old Woman Tossed Up in a Blanket, Constant Billy, Shepherd's Hay or Hey, Bluff King Hal, Trunkles, Blue-Eyed Stranger, Country Gardens, The Cuckoo's Nest, and Princess Royal.

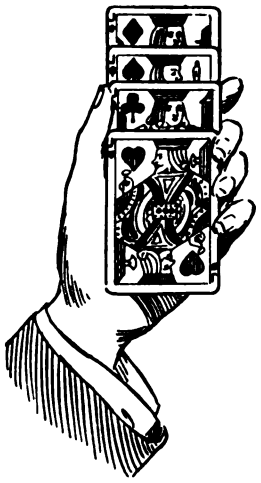
Thoroughly characteristic are the first two of these, which are here described in detail. In these dances six dancers form a set, and start in two files with faces towards the music, No. 1 dancer nearest to it, like this:

Dancer No. 5 partner with dancer No. 6
Dancer No. 3 partner with dancer No. 4
Dancer No. 1 partner with dancer No. 2

THE ROBBERS AND THE SOLDIERS

This card trick is very simple, but rather mystifying. It requires no expert ability to perform, hence it is one that is very suitable for young conjurers.

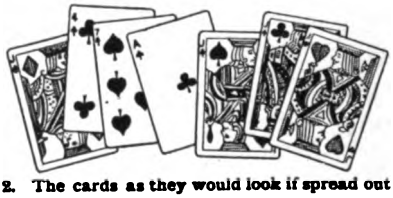
The conjurer has a pack of cards, and he takes out the four knaves, which he holds up to the company in the manner shown in picture 1. Then he tells the company his story. "Once upon a time," he says, "there were four robbers in Spain, and their robberies had caused them to be pursued by a band of Spanish soldiers. These four knaves are the four robbers. As they fled they came to a ruined castle, and the pack of cards here is the castle. The robbers entered the castle"—here the conjurer lays the cards in his hands, face downwards, upon the rest of the pack—"and held a council. They decided that one of their number should keep watch."



1. The four robbers

At this point he lifts the top card and throws it, face upwards, upon the table, then resuming: "That is the robber who kept watch, and the other three went down to the dungeon to sleep."

Here he takes the three cards on the top of the pack one by one, and, without allowing their faces to be seen, he puts them at the bottom of the pack. He keeps up his story as he does so: "These are the three robbers who went down to sleep, and it was agreed that, if the watching robber saw the soldiers approach, he should at once call the others. Shortly after midnight, the robber who was keeping watch saw, where the moonlight shone through the trees, that a company of soldiers was approaching. He immediately called to the others: '*Come up, come up, come up!*'"—here the conjurer flips the edges of the pack with one hand—"and immediately the robbers all sprang to their feet."



2. The cards as they would look if spread out

At this point he takes the three top cards in the pack and throws them, face upwards, on the table. They are the other three knaves, which the members of the audience are positive that they saw placed at the bottom of the pack. How did they get to the top? That is what the audience cannot understand, and what you want to know in order to be able to perform the trick.

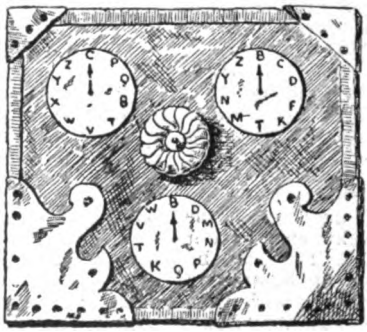
The explanation is very simple. The three knaves were not put at the bottom of the pack at all, although they seemed to be. The conjurer had seven cards in his hand, not four. Between the first knave and the second knave were three other cards—any three—from the pack, but they were placed so that they could not be seen by the spectators.

If the conjurer had spread out the cards, which, of course, he would not do, as it would have exposed the trick, they would have been like picture 2. Thus the three cards that were put at the bottom of the pack were the three hidden cards, not the knaves at all, and the knaves remained at the top of the pack, ready to be exposed as soon as the watching robber called: "Come up, come up, come up!"

This is a good trick, but it should not be performed too often in front of the same audience or it is very apt to be found out.

THE PUZZLE OF THE SECRET LOCK

Once upon a time there lived a very rich man who possessed a great number of very valuable vessels, made of silver and gold. From time to time, however, thieves succeeded in entering his mansion and carrying off some of these precious vessels. He therefore decided that he must have them locked up more carefully than before. Accordingly he gave instructions for a very strong safe to be made, and arranged that it should have a secret lock. On the outside of the lock were placed three dials, each with a pointer and ten letters on it. Before anyone could turn the handle which opened the door of the safe, he had to turn round each pointer to a certain letter, a different one on each dial. We see what the lock looked like and what letters were placed on each face in the picture, which is reproduced from Mr. Dudeney's "Canterbury Puzzles." Now, any thief endeavouring to turn the handle would, unless he were very fortunate indeed, take a very long time, as he might have to go through 999 combinations of letters before finding the right three. He told the three letters to his two most trusted servants, and, in order that they might remember them the more easily, the three letters formed a word. How many of us are able to discover what the word was?

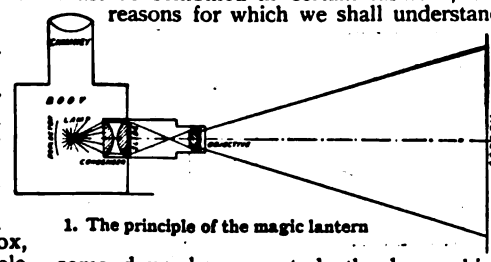


HOW TO MAKE A MAGIC LANTERN

It is well to mention at once that scientific people do not use the term magic lantern now, but prefer the term *optical* lantern. The prefix *magic* arose in an age when scientific men were regarded as magicians, or dealers in the black art, because their researches and methods were not understood by ordinary people. There is no magic or mystery in the lantern, but it is simply an instrument of scientific value, as well as amusement, in which the laws of optics are utilised to enlarge greatly the image of an object on the slide, and to make it appear on a screen.

There is much difference between the construction of a high-class instrument of science and the little lantern which is described here, but the principle is identical in both. The elements of any lantern are, as indicated in picture 1, the *body* or casing; the *condenser*, which receives light from the *lamp*, or other source of illumination, and transmits it through the *slide*; and finally the *objective* or magnifying glass, which focuses the light received from the condenser through the slide, and transmits it to the *screen*.

A single lantern can be made in several different ways, as well as in different sizes. A very elementary form of magic lantern might be made from an old tin cracker-box, with a cheap wall-back lamp and a simple lens, and a slide-carrier made from the wood of a cigar-box. But we are going to make something much more like a perfected scientific instrument, even if it entail the expenditure of a dollar or more. We shall adopt the old-fashioned oil-lamp to furnish the necessary light. It is not so bright as oxyhydrogen limelight, acetylene, or electricity, and it is very hot, but good results are obtained with a suitable lamp, well tended, and nearly all the smaller simple lanterns are illuminated in this way.

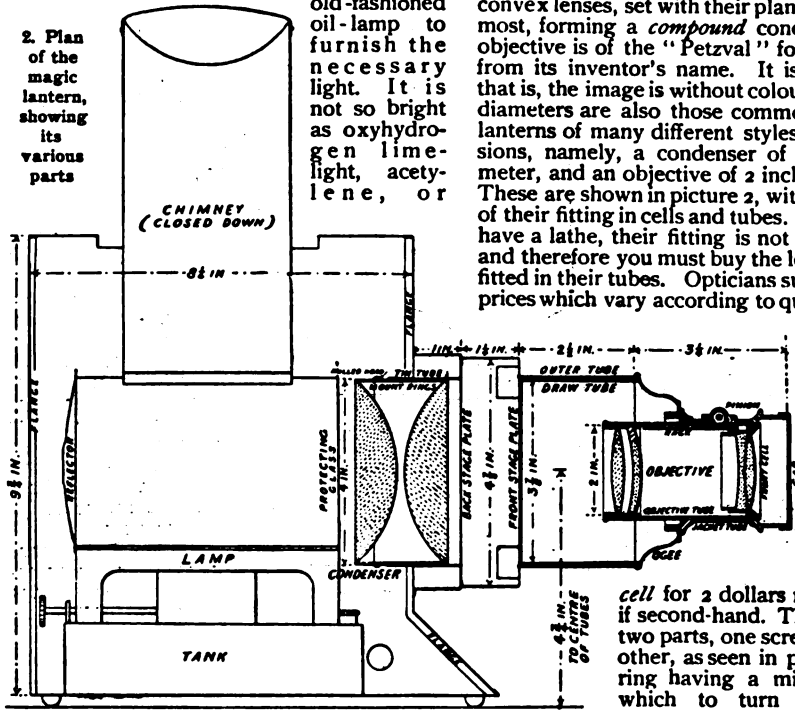


1. The principle of the magic lantern

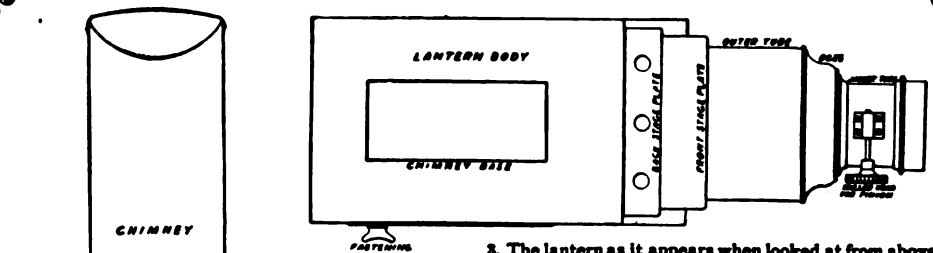
In settling the size of the lantern, the cost of fittings must be considered, because what are termed the *optical parts* must be purchased, as you cannot make your own condenser and objective, nor can you make very easily the tubes in which they are mounted.

The most important part of the lantern is the optical. On this depends the clearness of the picture thrown on the screen. Many of the cheapest lanterns have simple lenses, but they do not give bright, clear definitions free from colour rings. To ensure good results, lenses must be combined in certain fashions, the reasons for which we shall understand some day when we study the laws which govern the refraction of light. There are many such combinations. Those which we select for this lantern are shown in picture 2, and are the ones which are most generally used. The condenser is composed of two plano-convex lenses, set with their plane faces outermost, forming a *compound* condenser. The objective is of the "Petzval" form, so called from its inventor's name. It is achromatic, that is, the image is without colour rings. The diameters are also those commonly used for lanterns of many different styles and dimensions, namely, a condenser of 4 inches diameter, and an objective of 2 inches diameter. These are shown in picture 2, with the method of their fitting in cells and tubes. Even if you have a lathe, their fitting is not an easy task, and therefore you must buy the lenses already fitted in their tubes. Opticians supply these at prices which vary according to quality. Their names and fittings are as follows:

2. Plan of the magic lantern, showing its various parts



A 4-inch condenser, of compound plano-convex type, may be purchased ready in its *mount* or *cell* for 2 dollars new, and less if second-hand. The mount is in two parts, one screwed over the other, as seen in picture 2, one ring having a milled head by which to turn the screwed



3. The lantern as it appears when looked at from above

4. An outside view of the side of the lantern, showing how the base is carried forward in front to give extra support to the overhanging tubes

portion off and on. A few air-holes are made, to prevent mist from forming. The back lens is liable to become cracked by the heat of the lamp. For this reason the lenses are fitted loosely in their mounts, so that they will rattle, and the hinder one is often protected with a disc of plain glass, as shown in the picture.

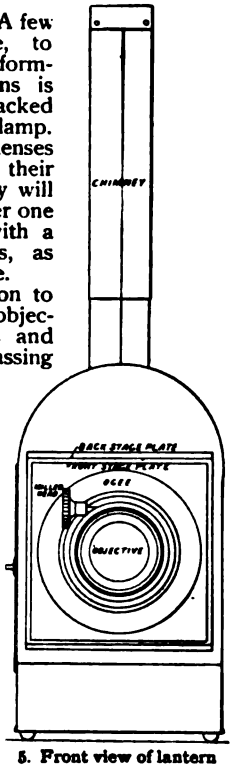
In essential relation to the condenser is the objective, which receives and transmits the light passing through the image to the screen. This is shown in picture 2, and comprises two distinct sets of lenses in a tube, which is slid by means of a rack and pinion in an outer or jacket tube — as also shown in picture 3—which has a connection to the condenser tube. The front combination comprises a double convex lens of crown glass—the front one in the picture—and a nearly plano-concave—actually a double-concave—lens of flint glass cemented to it with Canada balsam, the hinder one in the picture. This is mounted in a little cell—the front cell—distinct from the main objective tube, and screwed into the latter, to permit of cleaning the inner faces of both front and back lenses. At the back there is a concavo-convex lens of flint glass, separated by a small space from a double-convex lens of crown glass. These are both secured in the rear end of the objective tube as shown.

The front of the objective is often fitted with a hinged cover termed a *flasher*, which shuts off the image from the screen. In this one a cap is fitted to the front tube, like that used on some cameras.

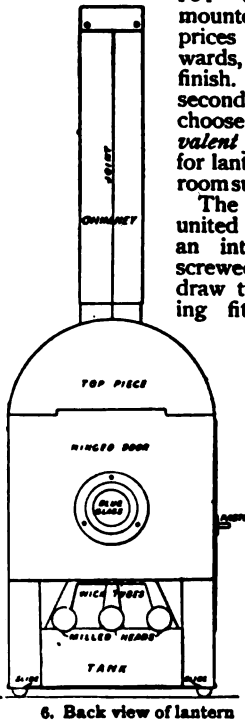
An objective of this kind can be purchased ready mounted in a polished brass objective tube, which slides in another brass tube termed the *jacket*, with a rack and pinion for effecting the adjustment. This is essential for exact focusing. Such mounted objectives are sold at prices ranging from $1 upwards, according to quality and finish. They can also be bought second-hand. The one we shall choose should be of *6-inch equivalent focus*, which is suitable for lantern work in an ordinary room such as we are likely to use.

The objective combination is united to a *draw tube*, through an intermediate *ogee*, being screwed into the latter. The draw tube is inserted, a sliding fit into an *outer tube*, as seen also in picture 3, which permits the lenses to be readily taken out of the lantern when not in use. The outer tube is fitted with an internal flange, and soldered to the *front stage plate* or slide-carrier plate.

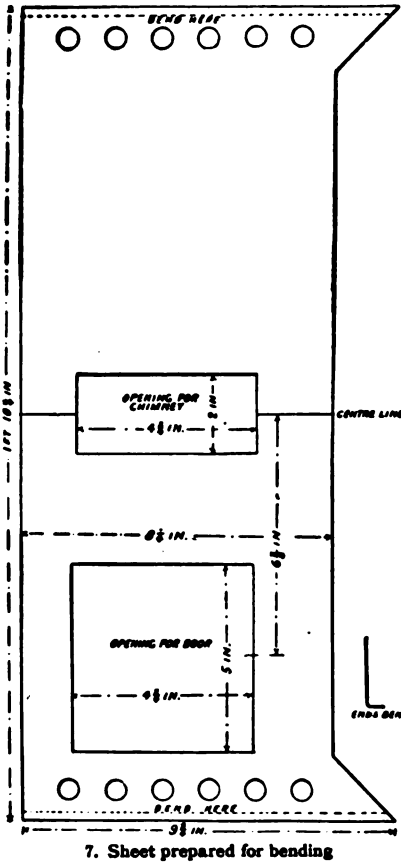
Between the condenser and the objective the picture slides have to be placed, and sundry plates have to be fitted to effect these connections. Behind the



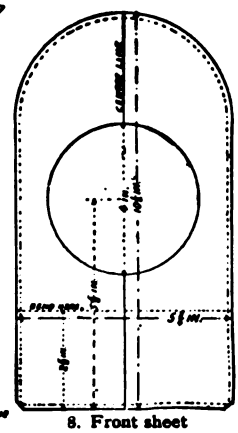
5. Front view of lantern



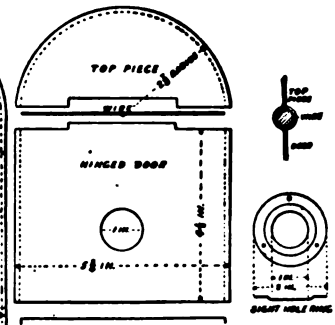
6. Back view of lantern



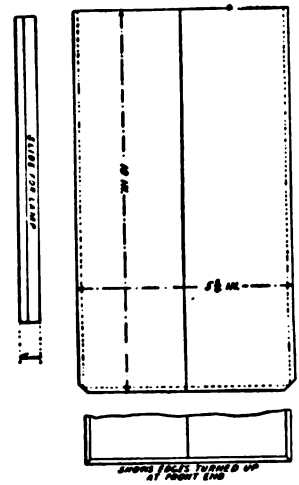
7. Sheet prepared for bending



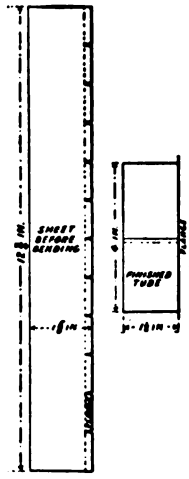
8. Front sheet



9. The parts for back of lantern



10. Bottom of lantern

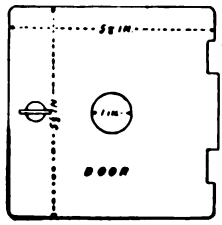


11. Tube for condenser

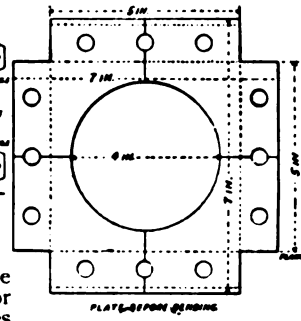
condenser is the lamp. These connections and details will be better studied after the body of the lantern has been made, which work we shall now take up. In the view given in picture 2, the lantern is supposed to have been cut down vertically through the centre. In picture 3 we are looking down on the outside of the lantern from above. In picture 4 we see the lantern from the side, in picture 5 from the front, and in picture 6 from the back. The base is carried forward at the front, as shown in pictures 2 and 4, to give extra support to the overhanging tubes.

The best lantern bodies are made of mahogany, lined with sheet iron, leaving an air-space of a quarter of an inch or so between the iron and the wood. We must make something simpler, as shown in the pictures. The body may be built either of sheet iron or of tin. Russian sheet iron is better than the ordinary quality. If tin is used it must be japanned black, but this can be done after it is made into shape. The tin can be cut with a strong pair of scissors, but if you can borrow a pair of shears from a friendly tinsmith the work will be rather easier. It is worked very readily, and you should meet with little difficulty in this part of the task. The lantern body, too, is designed as simply as possible, comprising only four distinct pieces of tin in the main portion. The sides and top are in one sheet, shown in picture 7; the ends are in two pieces, shown in pictures 8 and 9; and the bottom is in one piece, shown in picture 10.

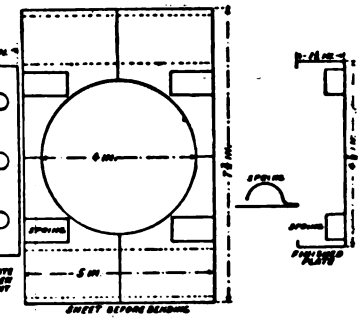
The sheet for the sides and top is made in one, to avoid jointing the top. It is cut to the dimensions given in picture 7, including an opening for the chimney, an opening for the door at the side, and six half-inch round holes are cut at both ends to afford draught for the lamp. When marking this out, start from the *centre line*, cutting each half on each side of this line exactly alike, with the exception of the door-opening. As you will not cut the edges exactly correct with scissors or shears, a file will have to be used to produce accurate results. Also, the back edge must be finished smoothly, as you might not be able to manage a beaded edge well, which is done in shop lanterns. The sheet must be bent to a semicircle at the centre, as shown in pictures 5 and 6. The easiest way to do this is to plane a block of wood to the curve, and bend the sheet round that until it fits the curve exactly. Or you might find a piece of pipe of about the right curve. The extreme ends must be hammered and



12. The side door



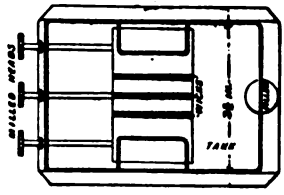
13. The back stage plate

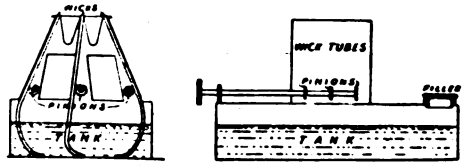


14. The front stage plate

bent sharply over the edge of a block of iron or wood, as seen in pictures 5 and 6, and enlarged in picture 7, the object of which will be explained presently. The front end sheet, shown in picture 8, is made to the dimensions given, and has one hole cut in it to receive a *tin tube*, as shown in picture 2, in which the condenser-cell or mount is inserted. This sheet must have its edges, except the bottom edge, bent round from the dotted lines, as shown, to form a little flange to give sufficient breadth of surface to be soldered to the sheet, which has been cut and bent from picture 7. You can just see this flange in picture 2. This can be bent with a pair of pliers, but slits will have to be snipped at intervals of about one inch round the curved portion at the top. The flange can also be bent by hammering it round the edge of a block of wood curved to the radius of the top. Bending at the bottom must be done to correspond with pictures 2 and 7.

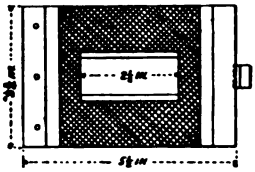
The back end piece, as shown in picture 9, comprises a semicircular piece at the top and a hinged door, seen also in picture 6. The first is flanged similarly to the front sheet, picture 8, and soldered to the top of the lantern. But a hinge has to be made in it, and the door fitted, before the soldering is done. Both pieces are notched, as shown in the picture, and turned over a piece of wire. An enlarged detail of this is seen to the right of picture 9. This bending over is done





15. The tank with wick for lamp

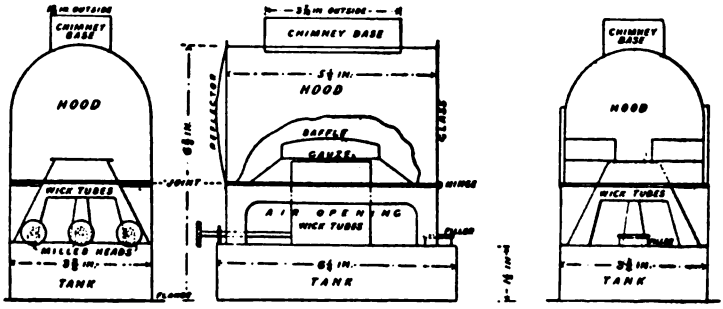
with pliers, and finished neatly with light blows from a hammer. The edges of the door are bent backwards towards the lantern body, seen below, to embrace the sides of the latter. A hole is cut to receive a disc of blue glass, used only if limelight is employed. The glass is held in by a ring riveted over it to the door seen to the right.



16. Bottom of hood with gauze

Picture 10 shows the bottom or floor of the lantern. It is turned up and round at the sides and front to embrace the sides and front of the body, as shown in pictures 2 and 6. The bending over is done with pliers, and may be finished by hammering, making a neat job without solder. Bent edges are seen at the bottom of picture 10. Knobs are soldered on the bottom to keep the lantern up off its support. The heads of large brass-headed nails will do for these, which are shown in pictures 2, 4, and 6. Two strips are soldered along the bottom inside, within which the foot of the lamp slides along, as seen in picture 6.

The door is fitted at one side, with a disc of blue glass in the centre, as seen in picture 4. The hinges are made separately and fitted to the door, and then soldered to the body, as in pictures 12 and 4. The glass disc is fitted as in picture 9. A fastening is made of a bit of brass, filed to the shape shown, and riveted to a pin which passes



17. Four different views of the lamp for the magic lantern

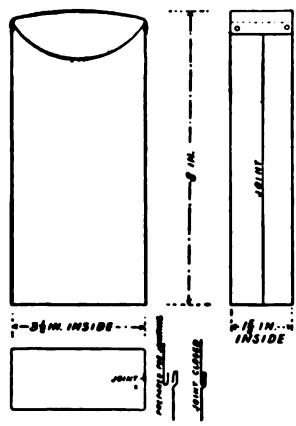
through the door and has a button on the outside to turn it by. A shop-made door is beaded, but beading may be omitted if the door is made of rather stout material.

We shall now take up the connection between the lantern body and the optical tubes. This comprises, as shown in pictures 2 and 4, a back stage plate, a tin tube, and a front stage plate, shown in detail in pictures 13, 11, and 14 respectively.

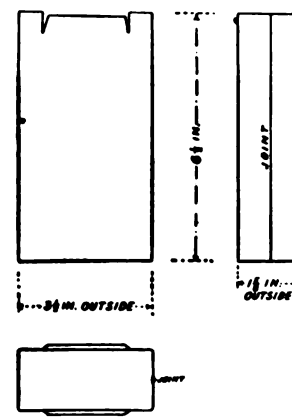
The *back stage plate*, as shown in picture 13, is made of a square sheet of tin, notched and cut at the four corners, and bent round square, the cut corners meeting. Three air-holes are also cut in each side, and the sides which are to form the top and bottom are bent round to form flanges, which are soldered to the front, as in pictures 2, 4, and 5. A little solder may be run into the corner joints.

Before the plate is soldered into place, the *tin tube*, shown in picture 11, is made by bending a flange on one edge of a strip of tin, snipping it at intervals with a pair of scissors, and bending it to form a circle, soldering the joint. The flange is then soldered to the inner face of the stage plate, and the tube passes within the hole in the front plate of the lantern, as seen in picture 2. The *mount rings*, or cell, of the condenser lenses fit within the tube, sliding easily therein. The *front stage plate* is made as in picture 14. A piece of plate, cut to the dimensions given, is bent round at two ends, and at each of these ends a narrow flange is bent for soldering to the back stage plate. A hole is cut through to receive the *outer tube*, which has a narrow flange provided to be soldered to the plate, as seen also in picture 2. Four brass springs are made, and soldered by one end only, at top and bottom within the plate. These are a substitute for the more troublesome springs and pins which are fitted to shop lanterns. They yield a little on the insertion of a slide, and so accommodate their pressure to various kinds of slides which have different thicknesses. We come next to the lamp and chimney, seen in position in picture 2, and separately in pictures 15 to 19. Nearly the whole of the lamp is united by solder, and the chimney by means of joints without solder, which would become melted in the intense heat. These lamps are sold very cheaply, complete with a chimney ready for use, but we describe and illustrate one for those who can spend the necessary time over the work.

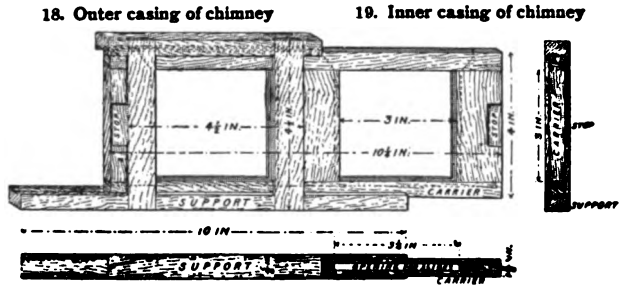
The lamp contains three wicks, each in a separate tube, for burning paraffin which is contained in the *tank* or reservoir at the bottom, poured in through a brass *filler* screwed at one end. The flanged edges of the tank slide along the ways soldered in the bottom of the body as in picture 6. The wicks are adjusted with the milled heads, each turning a toothed wheel beside its wick. The wicks approach at the top to give one broad flame. Air enters the openings provided at the sides and ends. The smoke is consumed in hot wire gauze and baffles, within the hood above. The hood is hinged, to throw back, to permit of trimming the wicks. When closed it rests on a light framework of wire soldered to the top of the tank. At one end of the hood there is a concave polished tin reflector to throw the light on to the condenser. At the other end a sheet of plain glass protects the condenser from excess of heat. Above there is a rectangular frame soldered on, over which the lower end of the chimney fits. The hood must be of blackened sheet, but the oil-tank is of common bright tin-plate. The method of union of the parts is shown in the pictures.



18. Outer casing of chimney



19. Inner casing of chimney



20. The double carrier for the lantern slides

The chimney, shown in pictures 18 and 19, is made in two pieces, with a *telescopic draw*. The two parts slide freely over each other. But to ensure that they shall remain as drawn out, at one end a breadth of the iron is snipped and pulled outwards to afford by its springiness a certain amount of friction. Picture 20 shows the slide-carrier, which can easily be made of wood from this design.

WHAT ANIMALS ARE THESE?

THE FIRESIDE GAME OF "WHAT-IS-ITS-NAME?"

We have given many questions which we can read out to our friends for them to answer on pages 2356, 2490, and 2570. Here are some more puzzle questions, which deal with some of the animals that are described in the Nature section of this book. The answers are to be found on page 2872.

THE LITTLE CREATURE THAT IS MORE CLEVER THAN MAN

1. In our garden there is a beautifully-made little creature which can do things no human being can do. It makes out of its own body a rope strong enough for it to walk on, yet so fine and straight that it is used in making the most delicate optical instruments. So thin is it that one hundred of its strands make only the thickness of a hair; so strong, that it serves as a net to entrap prey, and can withstand rain, wind, frost, and heat. See, here is one of our little friends up in the attic. It has four pair of legs, a body in two pieces, and eight little eyes, so no wonder it can see all about it. What do you think it is named?

THE ARMOUR-PLATED OLD MAN OF THE GARDEN

2. We find a very different animal hidden away under the lettuces. He has had one hundred and fifty birthdays and may have many more yet, for he takes life easily. He always carries his house with him. It is made of hard bony plates and a flat breastplate underneath, leaving a space in front for his head and two legs to peep out, and another at the back for his two short hind legs. If you hurt his feelings he draws back his head within his house. Let us tempt him with a nice juicy bit of lettuce. There, his slow, dull little eyes see it; he takes a bite and the piece is gone; but he may not eat again for weeks, and he goes to sleep all the winter in as cosy a corner as he can find. When he does move about he goes very slowly indeed, and many a more tiny creature could easily race him. He has a cousin who lives in a river, and another who basks on the sea-coast and who may one day be made into soup for dinner. When he himself dies his bony armour will be made into little boxes, and combs, and purses. What do we call him?

THE MOST AWKWARD ANIMAL ON THE EARTH

3. In the forests of Africa is an animal which in the course of ages has changed to suit its home. It liked to eat the leaves on the tall acacia, so it grew a long neck to reach them. Thorns of prickly plants, the leaves of which it wanted, pierced its lip, so it grew a hard skin to keep it from pricks. To protect its nose from thorns and sand blown by the wind, it learned to close its nostrils tightly. To get away from animals that attacked it, rather than fight, it lengthened its legs, so that it could outrun other animals. It is usually gentle, but sometimes gets angry and bellows. Its coat is covered with large spots. Each of the four feet has two toes, and the strong hoofs are used in fighting. Being so tall, it finds drinking very awkward, and has to straddle its legs almost like the legs of a camera. How should we like to stoop nineteen feet to drink out of a pond? Fortunately it rarely gets thirsty. What is the name of the animal?

THE JELLY THAT WRAPS ITSELF ROUND THE FOOD IT EATS

4. Living in a drop of water is a curious little creature, so simple that it is a mere speck of jelly. It has no real limbs, but it puts out "false feet" whenever it likes, and these it wraps round its food—a tiny living plant—without troubling at all about having no mouth. Its jelly-like mass thickens round the outside to form a kind of protecting wall. One peculiar thing this little creature can do is to divide itself into two new ones, each with a little dark part near its centre called the nucleus. So now it need not play about alone, for the two can float away in the water and seek their own adventures. Some of their relatives are dangerous and cause disease, another is kind and kills these when they get into our blood. What is its name?

A BIRD THAT IS NO BIRD, OR A BEAST THAT FLIES WITH ITS HANDS

5. To fly with hands! That is what we do in dreams, but there is a curious little animal that really uses its hands as wings, for it has made by the aid of its limbs a kind of parachute with which to fly. It suspends itself to the branch of a tree by hooks at the ends of its thumbs when it wants a rest, or decides to go to sleep during the winter. It likes to flit about in the twilight, and seems as though it would dash its little body against trees and houses. But no, it swerves aside, for though it has small eyes, it has large ears and a delicate sense of touch, so that it knows when danger lies ahead. It is very quick indeed in its movements in the air. It does good in our country by eating insects that are harmful. It is the only mammal that can fly like a bird. Can we tell its name?

THE ROMPING SCHOOL ON THE SURFACE OF THE SEA

6. Out at sea big dark creatures suddenly appear on the surface of the water. See, there is one. And now there are three more, tumbling about and rolling over and over. Look at the white on their under-sides. Now there is a baby one, and the whole family joins in a fine romp. A moment more, and they are all under water, diving for mackerel or herrings. They do not swim close in shore, but if we could see one near, we should find it has a very small ear, one nostril on the top of the head, and many sharp teeth in its jaws. On its back fin are little horny lumps, which remind us of the armour its ancestors used to wear. Its body contains much oil. We may have seen these creatures from a steamer round our American coasts. What are they called?

THE NEXT THINGS TO MAKE AND THINGS TO DO ARE ON PAGE 2867

WHAT THIS STORY TELLS US

IN the following pages we are told of the wonderful work of Mr. Luther Burbank of California. This man seems to be able to change plants of all sorts as he pleases. Yet the means he employs are very simple. The first plan is by selecting the individual plant which shows a quality he wishes to increase. Then the seed of this plant are sown and the individual plants showing an increase of the quality are selected and the seed from them are planted, and the process is repeated again and again until a plant very different from the original is secured. Then by crossing different varieties very many new and strange results are gained. You are told of some of the queer plants he has produced, and also what he hopes to do.

A WONDER WORKER IN PLANTS

To be told that we need not go on from one year's end to the next eating the same kind of fruits with the same flavours, admiring the same kind of flowers, smelling the same fragrance; that we need not make our bread, even, with the same kind of grain, sounds much like a fairy story, indeed. One can scarcely believe that shapes, colours and perfumes of flowers may be to our own choosing, and that new trees bearing a kind of fruit never before known, may be created at one's will. We are quite used to the fruits as we have them now and think of them, no doubt, as having always been as they are. Changes have been made in the plant world, however, which are very wonderful.

For example, the strawberry as it is today is a much improved fruit over the common wild strawberry, its ancestor. And this improvement has come through the great care that has been given to the strawberry plants for a long, long period of time. At first people were satisfied with the small, sour wild strawberry of the fields. If they transplanted it they took what they found and gave no thought toward bettering it. Later, however, only the best plants were encouraged and these were given every chance to do their best. In this way, the fine art of making new strawberries came and now we have berries varying greatly as to size, colour and flavour. But this has been the work of three hundred years.

WHAT WE ARE PROMISED

It is only after much intelligent and careful experimental work that we have been shown how nature's tendencies may be guided in a direction we ourselves choose, and bring results in a very short time. Nature's way can be discovered so that any one, without much difficulty, can breed new plants, new fruits, new flowers which will be more useful and more beautiful than any we have had before. Not only can new plants be called into existence but we can make those we already have much better. Better grains are promised, better vegetables in all forms, sizes and flavours; all the poisonous qualities can be taken out; we can have plants that can resist the effects of the sun, wind, rain and frost, fruits without stones, seeds or spines!

LUTHER BURBANK AND HIS WORK

The most successful man in changing and altering plants is Mr. Luther Burbank, known as the great American plant breeder. He was born in Lancaster, Massachusetts, March 7, 1849. He was a farmer's son and loved nature from the start. But to love nature was not enough. He under-

stood nature, too, and it was this understanding with his rare sympathy that made him able to do things with plants that no one ever dreamed of doing before. He did market gardening and seed raising in a small way and developed the Burbank potato while he was still a very young man.

In 1875 he left New England and moved to Santa Rosa, California, where he has since lived and carried on his work. Santa Rosa is a little Californian village lying in a fruitful valley. It seemed just the place for him to carry on the work he wished to do; for it has a wonderful climate and its soil is rich and varied. Here he lives in his cottage, covered with vines and blossoms and surrounded by his world-famous gardens. His experimental grounds are at Sebastopol, close by.

With untiring energy he carries on his experiments with all kinds of plants. Some of these experiments cover a period of twenty or twenty-five years — and even longer. A great worker, he never wastes a minute of his time and sees to it that you do not waste any of it, either! A large sign reminds visitors and the curious that they are allowed five minutes in the gardens!

Mr. Burbank's ways with plants are no secret. Most of the changes he makes in plant life are made either by selection or by crossing. I shall tell about the process of selection first, as that seems to be the simpler way of the two, and one that any man, woman or child might use if he but have patience and a love of the work.

What selection means

You have already been told that there is a tendency in each plant to be different in some particular from any other one of its kind. No two plants are quite alike. One is stronger than the other, the flower of this one is more brilliant than any of the rest, or another is larger in every way than its fellows. Mr. Burbank is ever on the watch for those qualities which he values most, and which he wishes to appear in the new plant he has in mind. So he often sows from 100 to 10,000 seeds of a given sort. When these grow up he selects 10, or it may be 50, often only one, of the plants, and these he lets live. He brings the flower to fruit and lets the seeds ripen. In turn, the seeds of the chosen flower are planted and a selection is again made from that group. Sometimes this selection and replanting is done again and again before he is satisfied with the result. Thousands of experiments are often made to get one plant, while millions of plants have been produced, kept, then cast aside that a few may be found worthy of cultivation. Perhaps the story of how his crimson poppy came will show best how this plan of choosing and selecting was used to bring an entirely new poppy among our flowers.

How new poppies were made

The fields of California are often golden with a wild yellow flower known as the Californian poppy. Mr. Burbank once noticed a little plant not quite like the others. It showed a delicate crimson streak on the inside of the flower. This was hint enough! He knew the crimson streak meant that crimson poppies had existed sometime in the past and that somehow they had been driven out. All they needed was another chance and they would come back. We shall see how Mr. Burbank gave them that chance. He guarded the little flower with the crimson streak in its yellow. He raised young poppies with the seeds from this flower. When these poppies bloomed many of them showed a touch of crimson and in some of the flowers more crimson was seen than was found in the mother plant. Another selection was made and the flowers showing the greatest amount of crimson in their petals were chosen and treated as the others. Each generation of flowers showed more crimson than the one before, until the pure crimson poppy as we now have it came back to us. The blue Shirley poppy has much the same history. Out of 200,000 seedlings Mr. Burbank discovered one flower showing a faint streak of blue. This blue was given its chance and the rest was a matter of selection, time and perseverance.

Mr. Burbank says he did nothing marvellous. He merely gave the crimson poppy and the blue poppy a chance to come back and they came!

There seems to be no limit to the results that can be obtained by this plan of selection. New species of wheat have, already, been brought out in this way.

THE PROCESS OF CROSSING

To make variations by crossing requires some knowledge of the structure of flowers. Yet, when one keeps in mind those parts of the flower which have to do with the production of seeds, it is all easily understood. The pistil is the organ of the flower which bears the seeds. It is usually in the centre of the flower and is surrounded by slender bodies with enlargements on the top. These slender bodies are the stamens and the enlargements are the anthers, which hold the yellow powder or pollen needed to develop the seeds in the pistil. When the pistil is full grown it is ready to receive the pollen. In a great many plants the pistils and stamens on the same flower are ready to do their work at different times. The anthers may have deposited all their pollen before the pistil is ready to receive it.

However, the wind carries pollen in all directions, and many insects, especially the bee, help to distribute it among the different flowers. But if no pollen at all reaches the pistil the seeds cannot develop and the pistil dies. Again, if the anthers were cut off before they open to discharge the pollen and the pistil were covered with a paper bag to prevent any pollen grains coming to it from anywhere, the pistil would die. And if all the flowers of its kind were taken away, the seeds could never be fertilised. All this is to show how necessary it is for the pollen to reach the seeds in one way or another.

HOW POLLEN MAY BE BROUGHT

If, however, you should *bring* the pollen from another like flower and deposit it upon the top of the pistil you would soon find the pistil maturing and the seeds forming as if you had not interfered with the flower in the least. This is just what Mr. Burbank does so skilfully. He holds the flower in one hand and with a camel's hair brush takes the pollen from the anthers of one flower and covers the pistil of the other flower with it. This gives the flower all the pollen it needs and just the kind he wishes it to have. Then he covers the flower with a paper bag so that no pollen carried by the wind or the bees can reach it. When these seeds are ripe they are sown and the resulting plants are somewhat like both plants concerned in producing the seeds. From this generation Mr. Burbank chooses again, pollinates again, and guards the seeds with the same care. Chosen ones are kept from each generation. This goes on and on until Mr. Burbank gets just the results he wishes.

NEW WALNUT TREES ARE DEVELOPED

It was in this way that the Paradox walnut tree came into existence. Pollen was taken from a flower of the English walnut tree and dusted upon the pistil of a flower of the California walnut. Great care was taken of this flower, and the nuts produced were planted with much interest. In thirteen or fourteen years walnut trees thirty or forty feet tall had grown up, unlike either one of the parent trees. The trees are large and handsome, but they are not good nut-bearing trees. However, in spite of their rapid growth, which is about four times as fast as that of the English walnut, the wood is excellent. It is fine and hard and of a very beautiful colour, and promises to be of great use to the cabinet worker. A row of the Paradox walnut trees grows in front of Mr. Burbank's home.

Crossing in the same way the California black walnut with an Eastern variety produces the Royal walnut. This is a handsome tree, but it is of slow growth. It has, however, a great nut-bearing capacity. Perhaps some day we shall have a tree with all the desirable qualities combined: one that will be a rapid grower, a great nut bearer, and with wood firm, strong and beautiful.

The experiments with the various

fruit trees seem to result in one surprise after another. He has given us about twenty new varieties of plums and prunes, many new apples, new cherries, new quinces, and one absolutely new fruit, the plum-cot, made by crossing the apricot and a Japanese plum.

PLUMS AND OTHER FRUITS

There is the Bartlett plum with its interesting history. The story is told that as Mr. Burbank was eating a plum one day, he noticed that it had a flavour similar to that of the Bartlett pear. He saved the pit, followed his usual plan of guarding and selecting, and the result is a plum which has the exact fragrance and flavour of the Bartlett pear

The Climax plum is the result of a crossing of the bitter Chinese plum and a Japanese plum. We also have plums with extremely small stones and plums with no stones at all!

HOW NEW KINDS OF APPLES ARE MADE

Some apples he has given us are larger and better flavoured than those usually grown. The varieties are endless. The same is true of the cherry, peach and quince. One would think that too much time must be given to allow for a tree's growing for one to make so many experiments in one lifetime. But Mr. Burbank overcomes time, or at any rate, lessens it, by his work in grafting. The seedling of a new variety of plant or tree is often grafted upon an old plant or tree and hurried forward. Grafting is placing a part of one tree under the bark or in the wood of another. If carefully done it grows

This graft draws nourishment from the fully developed circulation of the older plant. Were it not for this, we should have to wait years to discover what sort of new fruit we have. It takes from six to seven years for a plum tree to come into bearing. Out of thousands of seedlings the fittest (perhaps 10 or 20) will be taken and grafted on the branches of some full grown strong plum tree. In the next season that seedling will bear fruit. Sometimes twenty, or even hundreds of seedlings are grafted on one strong tree. In one instance he had 600 varieties of apples grafted on one apple tree. There were green, red, sour, sweet, etc. Plum trees, too, often carry as heavy a graft as this. If the fruits that result are all that is desired, the new apple or plum or whatever fruit it may be, is kept and by second graftings continues to grow.

NEW BERRIES DUE TO MR. BURBANK

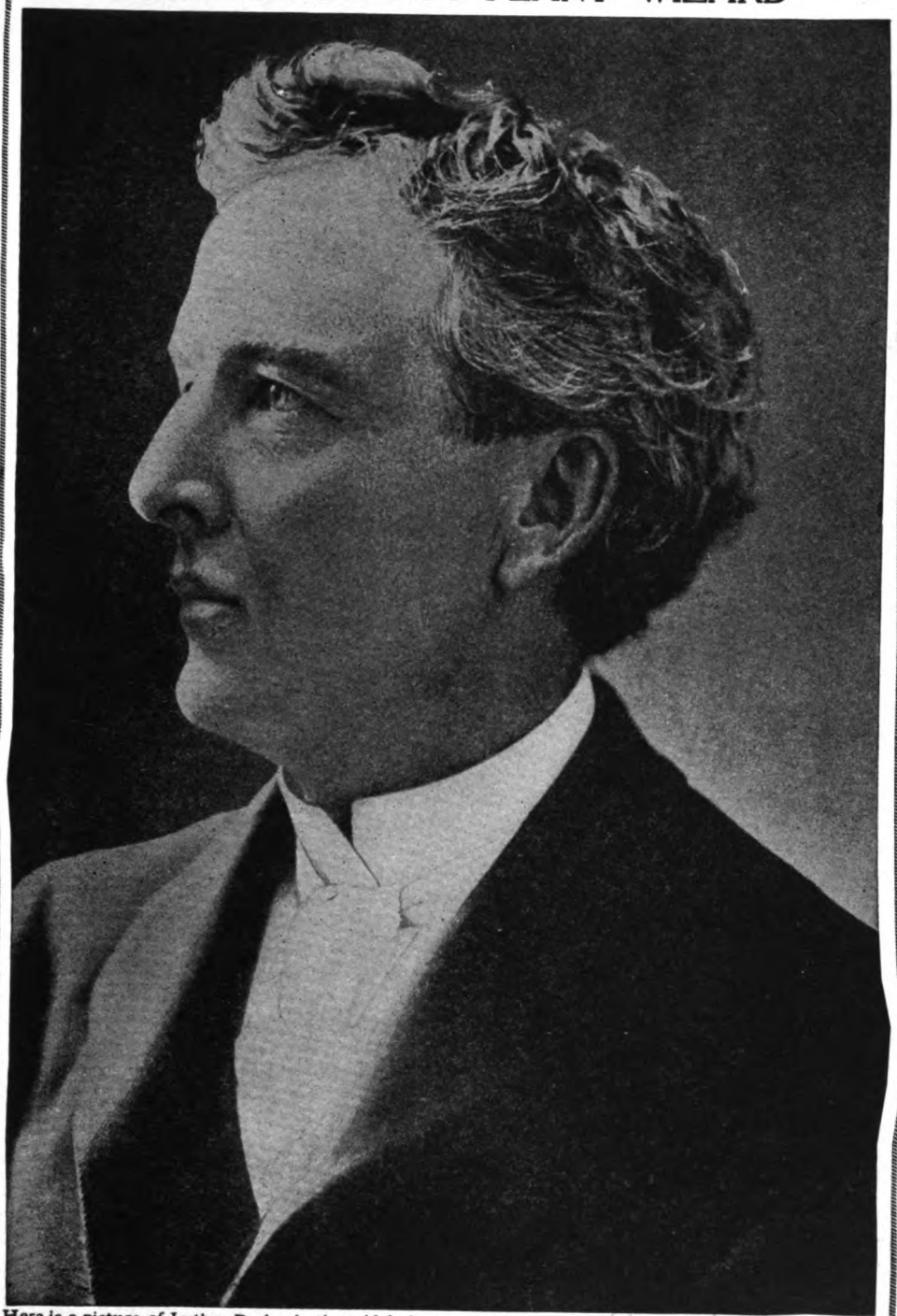
Next in extent to his work in plums and apples, is his success in berries. Here again we have a score of new varieties of great market value: better blackberries, raspberries, strawberries, and again one new berry, the Primus. This berry is a cross between the Siberian raspberry, a small fruit about the size of a half pea, brownish, seedy and tasteless, and the Western dewberry. It has the best qualities of both berries combined, and a perfect balance of characters. It is ripe before most of the other raspberries and blackberries begin to bloom. He does not recommend this plant, however, for general cultivation.

But when he "dehorned" the cactus it was said that he had done his greatest work. The cactus, as you know, is a fleshy-stemmed, prickly plant, usually without leaves. It grows in the dry hot regions where ordinary plant life cannot exist. Its thick skin keeps the great quantity of moisture found in the stem from being carried off too rapidly. The stems are full of this fluid and the fruit is quite eatable. However, the presence of the thorns, often quite strong and sharp, keeps the cactus from being so useful as a food for cattle as it would be without the horny spikes.

HOW THE THORNS CAME OFF THE CACTUS

To remove these thorns and improve the fruit was the work of much selection and crossing. An almost spineless species of cactus was used in the cross. In the first generation, the stock was prickly, in the second, less so, and in the third, the cactus was without thorns! However, when the spines did not appear on the stems, they were likely to be on the fruit, and when not on the

THE CALIFORNIA PLANT WIZARD



Here is a picture of Luther Burbank, the widely known Californian naturalist, who loves Nature so well and who has studied her so wisely that many of her profoundest secrets have become to him as open books. It is Luther Burbank to whom we owe the wonderful thornless cactus, and the Paradox walnut tree, whose wood of a beautiful colour promises to be very useful to cabinet-makers.

fruit, the stems bore them. By continued work along this line, we may have a cactus entirely free from spines. The fruit of this plant is fleshy and, especially in the opuntia, shaped much like a pear. In fact its fruit is called the prickly or Indian pear.

Mr. Burbank has 500 kinds of edible cactus with fruits; yellow, crimson and green, and with varying flavours. They grow in great quantities and are ripe all times of the year. With the thorns gone and the fruit improved, the cactus bids fair to be an excellent food for cattle, in dry regions. It has been used already in many places as green fodder, where other vegetation fails.

Failures as well as successes

One might go on and tell of endless experiments that this plant transformer has made, but I have chosen here only those with results bearing directly on our life. But not all experiments have had, in one sense, valuable results. Mr. Burbank has had his failures, as well. He himself is often surprised with strange and useless outcomes. A strawberry was crossed with a raspberry. He got a plant that looked like the strawberry and it sent out underground stolons, strawberry like. Later it sent up long canes from four to five feet high, in raspberry fashion. Then it burst into bloom and bloomed more than any strawberry or raspberry bush was ever known to do. But instead of the much looked-for berries it produced only small green knobs.

Chestnut trees 18 months old surprised him by bearing nuts two inches in diameter. Though but three feet tall, these trees were bowed down by the weight of their nuts.

Nature is sometimes wiser than men

Sometimes he is reminded that Nature has been wiser than he thought her. When he wanted a walnut with a shell thin enough to be broken with the fingers, he knew how to get it. But the birds and the squirrels found an excellent and easily gotten meal, and it was of no use for Mr. Burbank to try to get any of the nuts for himself. So he had to have the shells on his nuts as thick as they were before. The same thing happened when he bred the prickly burrs off the chestnuts. Again, only the birds and the squirrels were benefited, and the burrs were allowed to grow on again.

When the white blackberry, which he calls the Iceberg, is crossed with the red raspberry, about half the plants bear fruit like the red raspberry and the other half bear fruit like the white blackberry. But the flavour is that of both berries.

Beans of all sorts were crossed. They covered one-half acre. Some of them grew to be twenty and thirty feet high. There were all sorts and sizes of pods: some long and slender with long stems, some long with short stems; others short with long stems, while some long pods had stems so short that the pods themselves doubled up on the ground. From the red and white pole bean cross came striped pods, while the beans themselves were jet black. All the colours known in beans show themselves in the varieties that have come from this cross.

The little flower that died

Growing in Mr. Burbank's garden was a little plant with a small white flower. He believed this could be improved by a crossing with another flower which he had in mind. The result was the attractive mes-embryanthemum. It was a little plant that bloomed profusely and made a bright spot in any garden. But it had a short life. It lived just four years. Then all the plants, wherever they were located, died at once. Not one plant was left. No one knows why.

Mr. Burbank works no miracles. He says himself he just discovers tendencies in Nature, then chooses, encourages and guides those tendencies in the direction he wishes. And he says he can do this because the plant world is so very very old and so full of life. Nothing takes too long to try, no failure is too great to frighten him.

"My dream is that I may be able to point out to mankind the way to change the whole world of plants to suit its needs and pleasures."

THE BUILDERS OF FLORENCE

CONTINUED FROM 2710

THERE are four or five places in Europe to which all travellers desire to make their way. If they are not English, they go first of all to London. London has a certain wonde and grandeur, an evidence of wealth, with relics of history and great names, and withal a beauty of its own, different from the beauty of other cities. We read on page 1157 the story of the builders of London. Next, people want to see Paris, with its noble boulevards, its handsome buildings, and all the attractions which give Paris its special distinction. But the man who loves beauty in repose, the grandeur of sculpture, the dreams of genius fixed in stone, this man longs for the days which will take him to Florence, to Venice, and to Rome.

These beautiful cities are as different from the English cities as the lofty, mysterious Alps are different from the rugged Welsh and Scottish mountains. They tell of an entirely different past. The English never were an artistic people; the people of these fine Italian cities were.

The British glory in the achievements of Christopher Wren. He was the one Englishman of a century, and the burning of London presented him with an exceptional chance of adorning London with beautiful buildings. But the great architects and sculptors and painters of Florence and Venice and Rome were many. They were for the most part men in humble positions. They loved the tasks to which their lives were devoted, but works of genius were as much expected of them as good shoes are expected of an American shoemaker. To create beautiful buildings and sculpture was to these men something quite in the ordinary business of life. They did not always realise the splendour of their work. They gave the best of their talent, but gave it simply, without fuss or boast, seldom dreaming, perhaps, how future generations would marvel at their achievements.

If we stand amazed now at the beauty of these cities of Italy, we are not less surprised when we recall how these beauties were brought into existence. The cities were already old and well established, when it was decided to rid them of their ugliness, and to clothe their streets and squares with grandeur. It was a right and natural ambition, of course; but the wonderful thing is that the cities found ready, in the course of

no very long time, the men capable of carrying out, in the best possible way, the high ideals from which the search for beauty grew. Architects and sculptors arose whose works have seldom been excelled in the history of the world. Many of them sprang from such humble circumstances that we do not know their early history.

HOW ARNOLFO BEGAN THE GREAT WORK OF MAKING FLORENCE BEAUTIFUL

One of these men of humble birth is Arnolfo di Cambio. We meet him first in the company of a band of workmen who were engaged with him at work in the cathedral of Siena. He was still a young man, having been born about 1232. With him was a man named Lapo, whom he sometimes called his father and sometimes called his teacher. All these workmen were skilful artists, going from town to town in Italy, beautifying existing buildings or putting up new ones. It was Arnolfo that Florence chose to begin her great work of beautifying the city. The young workman became suddenly renowned as an architect and sculptor, and while similar tasks were being attempted in the neighbouring cities, he went swiftly to work to give Florence some of the buildings which to this day help to make her famous.

He was the father of her architecture. He surrounded the city with stately walls, he built her noble cathedral and two of her most beautiful churches, and he planned the famous public palace of the city, where the governors of Florence held their meetings. But Arnolfo could not finish all the great works that he began. He died in 1300, leaving something for those who followed to complete.

HOW CIMABUE BEGAN PAINTING REAL PICTURES & FOUND GIOTTO MINDING SHEEP

While Arnolfo was creating wonders in stone, a Florentine named Giovanni Cimabue, born in 1240, was adding to her pictorial treasures. The art of painting had at this time fallen very low in Italy. Foreigners, who all copied bad models, ruled the world of art. Cimabue began, as other young artists began, by copying these unsatisfactory models. Soon, however, his independence made him strike out for himself, and to paint men and women and the things about him as they really seemed. Because he tried truly to paint as he saw things, he is honoured with the title of the Father of Modern Painting. He died two years after Arnolfo, in 1302. But before he died he had trained a greater than himself to succeed him. This was Giotto di Bondone, always called simply Giotto.

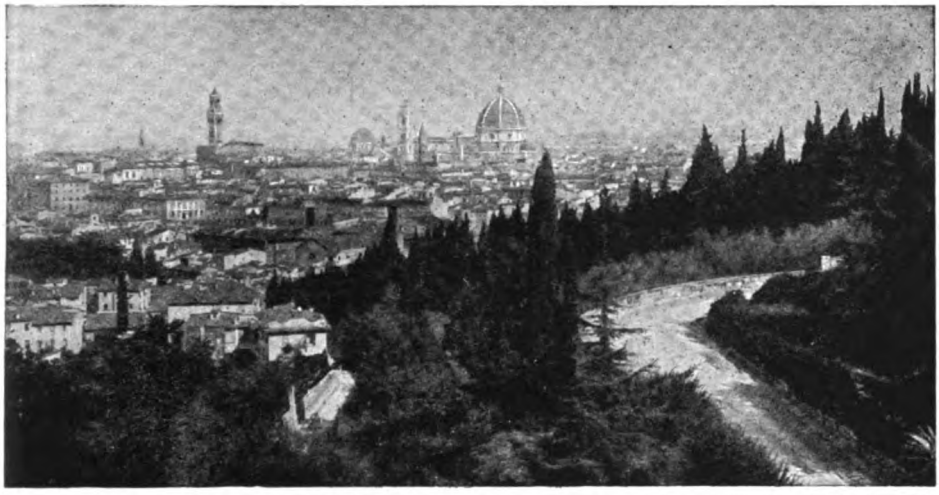
Giotto was born in, or about, 1266, the son of a poor peasant at Vespignano, near Florence. While he was still a little boy, Giotto was placed by his father with some shepherds to earn his living by watching the flocks. Giotto may have been a loving shepherd, but he loved art better. Without ever having had a lesson, he used to give all his leisure to drawing on the rocks with pieces of chalk. It is said that while thus engaged one day making a skilful drawing of a sheep, Cimabue found him. The great artist, pleased at the boy's industry and talent, asked if he would like to go home with him and learn to paint. Permission having been gained from the boy's father, Giotto was taken to Florence and instructed by his good friend. Giotto proved a ready pupil. He learned all that Cimabue could teach him, and proved better than his master.

GIOTTO, THE LAUGHING ARTIST WHO TALKED MERRILY WITH A KING

Cimabue had paved the way for a great change in the methods of artists; Giotto was really the first to give it expression. He was about twenty-four when he gained his first important commission. This was to paint a picture of Paradise over a church altar. An interesting thing happened about this. Dante, the great poet of Florence, was at this time living in his native city, and had shown himself a friend of the young artist. So, as Giotto sat perched high up on his little platform near the roof of the church, he thought of what he owed the poet, and showed his gratitude by painting a beautiful portrait of Dante among the angel faces of his picture. That portrait is the finest of the great poet that we have, for it was painted before sorrow and care had marred the noble features of Dante.

Giotto's talent was speedily recognised. He was paid to do paintings for the famous church in which St. Francis of Assisi is buried; for churches at Padua, Verona, Naples, and elsewhere, and, of course, for many in Florence.

THE VERY GREAT HEART OF FLORENCE



Florence has grown up, as it were, in the bottom of a basin, with majestic hills rising round about it as if to defend it from the rest of the world. High up on these hills—some of which are so high that their caps are white with snow—Florence began to be, more than a thousand years ago; but it was down in the plain that the dream-city arose, and it had its root in religion. There came down from the hill-tops a little band of exiled monks, who changed religion from a sleeping into a wakeful thing, so that churches and towers and domes began to rise; and there grew up the wondrous sight we see in these photographs—the great black and white marble cathedral with the wonderful dome, the quaint little baptistery in which for a thousand years every Florentine child has been taken to be baptised; with the towers and roofs of the little crowded red-tiled city packed closely round about.

Wherever he went he was always the simple laughing peasant turned artist. He had a merry jest for everybody, whether it was king or clown. Said a king who employed him: "I wouldn't work upon that scaffold this hot day if I were you." "Nor would I if I were you," answered the laughing artist.

How Giotto made a plan for the Pope and went to Rome

On another day he and a great lawyer were caught in a storm, and as they went their way, drenched and plastered with mud, the lawyer turned to Giotto, and, noting how comical he looked, said: "Do you think that anybody seeing you at this moment for the first time would believe that you are the greatest painter in the world?"

"Yes," said Giotto, "if he could believe that you knew your A B C."

Another joke of Giotto's was at the expense of the Pope. The latter sent a great man round to all the cities to collect specimens of the work of the artists, saying that the painter whose work he liked best should go to the Vatican to carry out a great scheme of decoration. The other artists were anxious to show the best thing they had done; but Giotto was not at all concerned. He took up his brush, dipped it in red, then drew with it a circle, so perfect that it looked as if it had been drawn with compasses. "Here is the drawing," he said, handing it to the envoy.

"Am I to have nothing but this?" gasped the man.

"That is enough, and too much," answered Giotto. "Send it with the others, and see if it is understood."

Apparently it was understood, for it is said that the Pope sent for him, and that he painted some pictures in St. Peter's at Rome.

The beautiful tower of Giotto that stands in the streets of Florence

When he was an old man, only three years from the grave, Giotto was made master of the public works of Florence, and given charge of the building of the cathedral, left incomplete, as we have seen, by the death of Arnolfo, thirty years before. Not only had Giotto now to superintend the work of others; he had to create, with measuring instrument, with hammer and chisel, as he had been wont to create with his paints and brushes. He was called upon to design a campanile, a tower in which to hang bells. He did the work with as light a heart as if it were an everyday occurrence. He planned and designed one of the most beautiful towers ever built. It is one of the marvels and beauties of Florence to-day, and visitors are proud to bring away from Florence bronze models of it. Not only did Giotto plan it, he worked with mallet and chisel at some of the carvings which adorn it. One of the carvings represents a little puppy, a puppy which he had loved as a child when minding the sheep, and had remembered, years and years afterwards, when he was one of the most famous men in Italy.

The beloved Giotto passed to his rest in 1337, and we have now to go forward and leave the work of making Florence beautiful to artists of skill, but less famous than those whom we are considering. We take up our story again when we find in Florence three other wonderful men. These are Filippo Brunelleschi, born about 1377; Lorenzo Ghiberti, born in 1378; and Donato Di Betto Bardi, called Donatello, born about 1386.

The gates for which all Italy's artists made plans

The first two came into prominence when Ghiberti was about twenty-four, and then met as friendly rivals. Ghiberti was of poor family. We know nothing about his father, but we hear of his stepfather, an excellent man, named Bartoluccio, who instructed young Ghiberti in his art as a goldsmith, then did a wise thing by sending the lad travelling, to enlarge his knowledge of art, and, at the same time, to earn his living.

Ghiberti was a wonderful fellow. When he was not painting pictures he was modelling in wax, or making figures in bronze, or doing something with trinkets. Before he turned his face homeward, he had earned fame by painting some fine frescoes in a palace at Rimini. He was working at Pesaro when he got a letter from his anxious stepfather telling him that all the most skilful artists in Italy were summoned to show their genius in designing gates of bronze for the famous church of San Giovanni, the church to which all the children of Florence were then, as now, taken to be christened. Here was Gilberti's chance. He needed not his

THE BEAUTIFUL "GATES OF PARADISE"

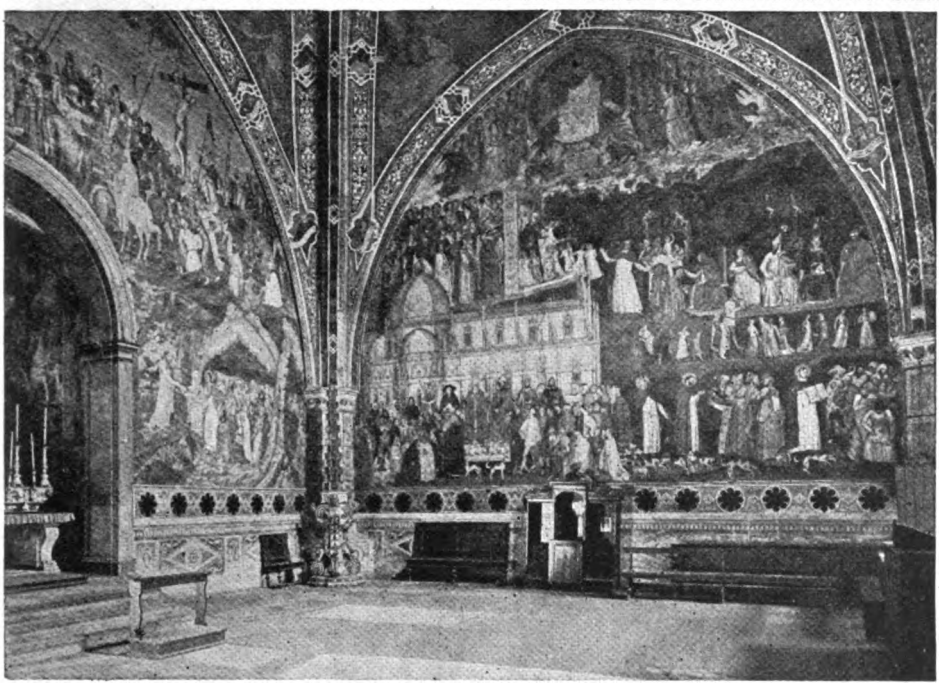
In the open streets of Florence, with the rain pouring on them for hundreds of years, hang these wondrous gates. They are the main gates of the little baptistery which was the chief church in Florence before the great cathedral, now facing it, was built. They are, perhaps, the most famous gates in the world, and they took nearly thirty years to build. They were designed and carried out by Lorenzo Ghiberti, who began them in 1425 and finished them in 1452. Michael Angelo thought them fit to be the gates of Paradise, and they are among the most wonderful things in a wonderful city.

LOOKING DOWN A FLORENCE STREET

We have in this picture one of the most striking glimpses of the streets of Florence. On the right and left are the long corridors of the famous Uffizi Gallery, full of priceless paintings, and beyond, rising to a marvellous height, is the wonderful Vecchio Palace, built of huge stones hundreds of years ago. Here Lorenzo the Magnificent held his luxurious court, patronising painters and sculptors; here, in a little cell at the top of the tower, Savonarola, the eloquent monk who preached to the Florentines, spent his last night on earth. In the niches between the columns are statues of great men of Florence whose names are famous throughout the world.

THE CHURCH WALLS OF FLORENCE

THE MOTHER OF JESUS IN HER HOME, PAINTED IN THE CHURCH OF SANTA MARIA NOVELLA



THE WONDERFUL WALLS OF THE SPANISH CHAPEL IN THE CHURCH OF SANTA MARIA NOVELLA

Florence holds us captive everywhere, indoors and out. The walls of its churches are covered with priceless paintings. No picture can represent them as they are, but we give here two photographs of the walls of the church of Santa Maria Novella, which help us to understand the splendour of the church walls of this city.

The photographs on these pages are by Underwood & Underwood, London, and Alinari, Anderson, Brogi, and Manelli, Italy.

stepfather's bidding to hasten home; so anxious was he to reach Florence that the journey seemed to him, as he said, like a thousand years. He drew his plan, and sent it in to take its place with the designs of the most famous men of the time.

THE GREAT CHANCE OF GHIBERTI'S LIFE AND THE USE HE MADE OF IT

Among the other competitors was young Filippo Brunelleschi. He was a lawyer's son, and his father had desired him to follow the law. But Filippo early gave his heart to the work of the goldsmith, and dearly he hoped now to win the prize. When the designs were exhibited he took with him his humble young friend, Donatello. They examined them all, and saw that Brunelleschi's was better than all save that of Ghiberti, which was superior to all the rest. And so the judges found. Ghiberti was ordered to undertake the work; this young wandering workman of twenty-four was chosen before all the other artists who competed.

To understand what Ghiberti had undertaken we must examine the picture of the gates, on page 2783, or, better still, see the cast of them, which may be found in a museum, if we cannot go to Florence. It proved to be the work of Ghiberti's life. The first pair of gates took twenty years to make, and the second pair, shown in our picture, even longer. Thus fifty years of his career were given to the work, which was not finished until Brunelleschi was already in his grave. But while Ghiberti was doing the gates with the assistance of a staff of artist-workmen, he was engaged in other labours, too. He did some beautiful work for two or three churches of Florence, as well as for the cathedral; he modelled fine statues, and did some beautiful goldsmith's work.

THE GATES THAT MICHAEL ANGELO SAID WERE FIT TO BE THE GATES OF HEAVEN

Ghiberti was even given part share with Brunelleschi of the building work at the cathedral, but here as a builder he was a failure. Brunelleschi could not work with him, and had to refuse to go on unless Ghiberti were kept to work of his own; and, even when they were able to give him his own work, Ghiberti was found to be incompetent for building, and was removed. His grandest monument is the wonderful pair of gates, which for mingled grace and grandeur are finer than anything else of the sort in existence. Michael Angelo declared that they were fit to be the gates of heaven. Ghiberti loved the work, and he gave the best of his life to it. Though its progress was so slow, all the most exalted people in Florence were interested in it. In those days Florence was an unlighted city at night, save for the torches which people carried, and everybody not specially authorised had to be indoors by dark. But Ghiberti, though no higher in rank than the rest of the common people, became a great public character when he began the gates, and he and all his workpeople were allowed to walk about the streets at night and to carry lanterns, at whatever hour of the night they liked—a rare privilege indeed in those days.

It was well for Filippo Brunelleschi that he did not get permission to make the gates, for there was other important work for him to do, even greater in some respects than Ghiberti's. Himself an ugly little man, he had a soul for beauty, though not one of the kindest of natures.

HOW BRUNELLESCHI BUILT THE DOME THAT IS STILL THE GLORY OF FLORENCE

Having failed in his contest with Ghiberti, he went off to Rome to indulge his passion for architectural drawing. He had already sketched every building in Florence, and he longed to make a new drawing showing how Arnolfo's grand cathedral could be completed by the addition of a dome. So at Rome he studied all the great buildings. He made drawings of them; he noted how they were constructed, how beauty was combined with strength, and lightness with mass. In order that he might have money to live on, he would work during the day for the goldsmiths, then at night go on with the drawings of his beloved buildings. Never did a man more thoroughly train himself for a task than did young Filippo for the dome of the Florence Cathedral.

At last, in 1417, when he was forty years of age, he returned to Florence, and offered to the city authorities plans for the building of a dome. It took the wise men of Florence several years to come to a decision. In that time every sort of objection was raised, and

A STREET CORNER IN BEAUTIFUL FLORENCE

It is a wonderful thing to walk about the streets of Florence. If we have any love of the beautiful, or any sense of the mystery of the past, there comes to us as we walk about Florence something of the feeling that poetry gives. We seem to be out of the everyday world, and in a beautiful dream. This picture shows us the wonder that bursts upon our view as we turn a street corner in Florence. We are at the famous meeting of the ways in the Cathedral Square, at what is called "the very great heart" of a city that has drawn men to it for a thousand years. All roads lead to this square, and the dome of the great cathedral and the majesty of the Lily Tower are even more impressive in this nearer view than they appear to us from the height of the hills around.

everybody's opinion was taken. Other artists made designs, and the wildest of schemes were suggested for carrying out the work. But in the end Brunelleschi gained the day, and was told to carry out his plans. His one sorrow was that Ghiberti, who now stood high in public favour, was to share the labour with him. Brunelleschi knew that Ghiberti was quite incapable of the work, and felt that he himself would have all the labour, but would have to divide the honour, as well as the payment, with Ghiberti. That is why he fought against Ghiberti, and eventually got him discharged from the work.

The dome took over forty years to build, and Brunelleschi had been fifteen years in his grave when it was completed. But his plans were so perfect, his methods so excellent, and his personal labours during the last twenty-six years of his life so persistent, that the faithful band of workers who followed him had but to carry to the obvious end what he had begun, to make his work one of the grandest features in the architecture of Europe. He crowned with a dome of grace and splendour the majestic cathedral begun exactly 150 years before the dome was finished. Measured across, the dome is still one of the biggest in the world, and its beauty remains unsurpassed.

THE MERRY DONATELLO AND HIS WONDERFUL FIGURES IN STONE

So far we have met Donatello only by name. He was the young friend who went with Brunelleschi to see Ghiberti's drawing for the gates. He was one of the merriest fellows, and perhaps it was because of the youth's sunny nature that Brunelleschi, who was ten years older, became his friend and companion. Donatello was the son of a wool merchant, who apprenticed him to a man who is supposed to have been Ghiberti's stepfather. At any rate, the boy learned, like Brunelleschi, the goldsmith's art, and, going to Rome with his friend, was able to support himself there by his skill in working in metals.

While Brunelleschi was studying the classic architecture of Rome, Donatello was studying the statuary. He had not his friend's capacity for great schemes and buildings, but he had just as fine a genius, and though he laughed and joked his way through life, he was destined to become Italy's greatest sculptor of later times, and the father of modern sculpture.

Before he went to Rome as a boy of fifteen he had carved a crucifix in wood, a statue of Mary Magdalene, and a marble statue of St. John, each of which may still be seen in Florence to-day. When he returned from the Eternal City, as Rome is called, he was twenty-one, and a finished sculptor.

DONATELLO'S STATUES FOR GIOTTO'S TOWER, & HIS FIGURE OF ST. GEORGE

Giotto's noble tower still needed some decoration, and Donatello was one of the sculptors engaged to complete it. He carved for it a lifelike figure called Zuccone, and as he gazed upon his finished work he took up his mallet, and, giving the statue a playful tap, said to it: "Speak!" Michael Angelo, who was not born until nine years after the death of Donatello, saw one of Donatello's famous statues. This one was the wonderful figure of St. George, clad in mail, looking as if it is ready to step down from its pedestal and do battle against wrong-doing and evil. And as Michael Angelo looked, he remembered what Donatello had said to Zuccone, and he himself now shouted: "March!" Could there be a finer compliment to a great sculptor's work?

All Donatello's statues are famous. They are beautiful in themselves, but they are important because of the effect they have had upon later sculpture. He had closely studied the glorious work of the ancients, and he reproduced their methods, stamped with his own genius. Until his day, men had been content to let the statues they carved be part of the buildings to which they belonged, as a cornice or a scroll is part of a building. Donatello made them actual portraits in stone, things of life and beauty, independent of their surroundings; figures whose merits command attention and admiration for themselves.

THE MODESTY OF DONATELLO, AND THE FAME OF THE DELLA ROBBIA FAMILY

From his thinking so highly of his work that he bade one of his statues "speak," it might be thought, perhaps, that Donatello was a vain man. But he was not. When people greatly praised him for his work in Padua, he said that he must return to Florence. "If I stay here, where I am praised by

GIOTTO'S DREAM OF THE LILY TOWER

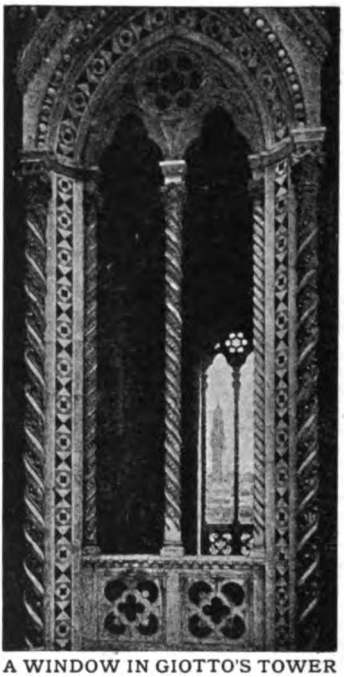
In this picture the artist has tried to show us the young Giotto minding his sheep, drawing on stone, with rough chalk for pencil, as Cimabue found him; and the artist has fancied Giotto dreaming of the beautiful tower he was to raise in the streets of Florence. We fancy Giotto saying, "I will build you a beautiful thing," and as we look at the Shepherd's Tower, so pure that it is called the Lily Tower, there comes to us something of the feeling that must have been in Giotto's heart when he chiselled his marbles. The foot of this tower, says Mr. Ruskin, is the one spot, out of Palestine, where we feel the dawn of the morning of the world. Behind us is the little baptistery, the last building set up on the earth by the men who learned their work from pagan teachers; in front of us is the best building set up on the earth by the men who learned their work from Christian teachers.

everybody," he said, "I shall soon forget all I know. At home in Florence everybody abuses me, and thus I am kept up to the mark, the constant blame forcing me constantly to study and, consequently, to do better work."

He had a joke and a kind word for everybody who deserved them, but once when a niggardly man complained that the sum charged by Donatello for a great head amounted to 25 cents a day for a month, he took his hammer and smashed his work to pieces.

It was not that he cared anything about money. All that he earned he used to put in a basket and hang up in his workshop, so that his friends and workmen could help themselves without troubling to ask him. He lived through a happy old age, and died when he was eighty.

The lives of the men we have so far studied show us that the decoration of Florence was an unbroken series of works, spread over many years. The next man of genius to carry on the work was the great sculptor, Luca Della Robbia. He was born in Florence in 1400, and was one of Ghiberti's pupils. He took to art as naturally as Giotto had done, and showed such skill in working with marble and bronze that in 1437 he was ordered to complete the series of carvings in relief on one of the sides of Giotto's campanile.



A WINDOW IN GIOTTO'S TOWER

The work was so beautifully done by Luca that it is hard to tell his work from that done by Giotto at his best. Donatello had done some famous carvings in the cathedral, and Luca was given the task of carving a similar set for another part of the cathedral. Donatello's were wonderful, but Luca's were even better. They were figures of singing angels and dancing boys, and were beautiful as the hand of man could make them. A copy of these may be seen in some museums.

This was not the only time that Luca Della Robbia and Donatello were rivals. The jolly Donatello was ordered to make a bronze door for one of the cathedral chapels, but he was too busy, or too happy, in doing other things, so the work was taken from him and given to Luca. The latter took twenty-one years over his task, but it was work fine enough to have occupied an artist a lifetime. The door is divided into ten panels, and the figures in it seem alive.

The statues done by Luca were excellent, and one, of the Bishop of Fiesole, is still famous. Much of his time was given to work in terra-cotta reliefs, that is, figures standing out from the flat surface from which they are modelled. He covered these figures with an enamel which he is said to have invented. The same sort of enamel had been used in Persia 200 years before, but there is nothing to show that Luca knew of it.

There were other Della Robbias after Luca. He taught his nephew, Andrea Della Robbia, and Andrea taught five of his seven sons, of whom Giovanni was, after Luca and Andrea, the most famous of this talented family. Two of the seven sons became monks in order to follow Savonarola. These two sons of Andrea would thus be drawn into the company of Fra Bartolommeo, who, born in 1475, became one of the most renowned of Florentine artists working at the monastery of San Marco, where also worked Fra Angelico, another famous artist monk, of whom we read elsewhere.

Afterwards there came to Florence the great Raphael, of whom we read on page 758. He was eight years younger than Bartolommeo, but he was able to teach Bartolommeo, and the monk was able to teach him. We read Michael Angelo's wonderful life in the story of the makers of Rome, but Florence was the city of his birth. He was born there in 1475, and carried out there some of his finest work.

The next Men and Women begin on 2909.

WHAT THIS STORY TELLS US

WE have learnt what are the various kinds of things which either must be included in our diet on pain of death or, like sugar and fat, are extremely desirable, though not quite necessary for life. But, as a rule, the foods which we eat do not consist of, say, pure proteid, about which we read on page 2699, but of a great mixture of food-stuffs, together with a quantity of material which cannot be digested at all, and usually with a great admixture of water. We now begin to study some of our common foods to see how they rank when they are examined chemically, and to learn how far we are wise in using them. We may find, for instance, that clear beef extract, which is regarded as a food by many people, contains none of the substances necessary for life except water and salt; and with people for whom money is scarce, this is a very important thing to know.

NATURE'S WONDERFUL FOOD

CONTINUED FROM 2700

THERE is only one instance in which Nature has set out to make a food. The wheat plant grows, and produces food material in its grain, not for the sake of the children of men, but for the sake of the children of wheat. The fish, the sheep, the chicken, and the egg come into existence as part of the life of the living races to which they belong. The time is for ever past when we can have the folly to imagine that the only purpose these things have is to serve us. If we leave ourselves out of the question altogether, we still find that throughout the whole of Nature, with one exception, the animal and vegetable food of living creatures was not first brought into being to be a food, but was brought into being for itself, to live its own life. Only once has Nature set out to make a food—a substance brought into being and existing only in order to be a food.

We may reasonably expect that this food will be hard to beat, that it will contain everything necessary for life, and that it will contain these things in the exact proportions that are needed. That is precisely what we find. There are as many kinds of milk as there are kinds of mammalian animals, or mammals. The word comes from *mamma*, which is the proper name for the udder of a cow. In each case the young creature has different needs. It may be a young whale, or a young antelope, or a young human being. These lead different lives in different surroundings and different temperatures; they develop at different rates, and therefore the milk provided for these creatures differs suitably in each case. More than this, it differs from week to week, or month to month, according to the needs of different stages of development in the young creature.

The needs of all life are really the same. Every kind of milk that exists contains proteid, sugar, fat, and various salts; but the proportions of these things differ. Now, the milk we are to study here is cow's milk, simply because that is what we usually drink; and though we said that milk is a perfect food, we are to understand that each milk is a *perfect* food only for the creature for whom it was made. The cow's milk was made for the calf, for whom it is a food perfect, and complete; it is not so for the human baby, nor for grown-up human beings, nor even for grown-up cattle. The objection to it in the case of ourselves, when we are grown up, is only a slight one, namely, that it is rather too dilute, which means that it contains more water than is quite convenient. Yet no one can name any other food that is so nearly perfect even for grown-up human beings as cow's milk, and people can live upon it and recover health from it after the gravest disease without the help of anything else.

Milk and its products, especially cream, ought to be the great staple of

the diet of children. No baby, of course, could survive without milk; and the needs of the small baby, as it grows older, do not change so quickly as some people suppose. The commonest mistake in the feeding of children in the second and third and fourth year in America is not giving them enough milk.

Nothing could be a greater mistake than to judge the value of foods by their stiffness and solidity. Plaster of Paris is stiff, and milk is not; milk is a perfect food, and plaster of Paris is no food at all. We underestimate the value of milk simply because it is a fluid, but we do not suppose that a lump of sugar is lost when it is melted in a cup of tea. We quite understand that the sugar is still there and that we are getting it. Now, milk is really made of various things, just as solid as a lump of sugar, which have been melted in water simply for convenience. Directly milk is swallowed, it is promptly turned into solids, or is clotted, as we say. This is done by a ferment in the stomach. It is well to add a little rennet, which is really the same ferment, to a glass of milk, so as to satisfy ourselves that milk is really "solid nourishment."

THE THINGS THAT MAKE UP THE GREAT VALUE OF MILK AS FOOD

When milk clots, in the stomach or outside it, it forms a curd, which consists of most of the proteid of the milk and all the fat. The clear whey which is left contains the sugar, the salts, and a small part of the proteid of the milk. It follows from this that it is possible to live on whey, and, though it is rather a thin kind of nourishment, it saves the life of many a baby who can use nothing else. But no one could possibly live on curd only. Let us consider for ourselves what it is that curd lacks which is necessary for life, and which whey, though it looks so poor compared with curd, contains. The particular proteid in whey—without which, of course, it could not sustain life—is perfectly well known to all of us. For when we boil milk it slowly stiffens, and forms the "skin" on the top, which a few grown-up people and many children throw away, but which is one of the most valuable things in milk. The sugar of milk is a special sugar which is not found anywhere else. It is rather less sweet than the sugar we put in tea. It has the beautiful property of being far less ready to be broken up by microbes than any other sugar. The invaluable salts of milk, upon which bones and teeth, to mention nothing else, depend, always include the following elements: potassium, sodium, calcium, magnesium, iron, phosphorus, and chlorine. The proportion of potassium is strikingly high because that is specially required for the growth of muscle; as for the lime or calcium, no other food, except yolk of egg, contains so much.

ONE OF THE COMMON DANGERS OF THE COMMON USE OF MILK

Milk is very apt to contain all sorts of unusual things because it offers to the body one of the means by which these may be got rid of. This is very important practically, because it applies to all kinds of milk, and it means that many babies are injured because they get in their mothers' milk, alcohol which those mothers have drunk, perhaps on the advice of ignorant doctors who think that alcohol makes good milk. Also, all sorts of medicines pass in this way, and often the best way to give medicine to a baby is to give it to its mother.

Now, all this applies to cows. If improper things are given to cows as part of their food, the cows are very apt to get rid of them in their milk. Every day in the year many human babies suffer, and not a few are in the long run killed, because they are upset by swallowing cow's milk containing all sorts of oily substances given to the cow, because they appear in the milk, and look like cream. They are not cream, however, but dangerous intruders in the milk.

HOW A DOG IN THE FARMYARD MAY SPOIL THE COW'S MILK

All kinds of excitement and worry also affect the composition of milk, and every careful farmer knows that, if he wants consistently good quality of milk from his cows, he must neither send them to be exhibited at shows, nor must he, for instance, allow a dog to get among them and frighten them. The making of milk is an act entirely under the control of the nervous system, and if the nervous system is thrown out of gear, the milk produced may be actually poisonous.

The great difficulty about cow's milk, not only in the case of babies, but also in the case of many grown-up people, is that, when it clots in the stomach, the clot is very dense and thick, and therefore difficult to digest. The calf has far stronger powers of digestion than we have. The remedy is to add to the milk a little soda-water or lime-water, and then we find that the clot which is formed in the stomach is light and loose and flaky.

Cream contains the whole of the fat in milk, but it is a mistake to suppose that that is all. A good deal of the proteid is caught up in the cream too, and thus cream is a very highly concentrated and excellent food, though, of course, not a complete food. There is no form of fat or oil, whether derived from the sheep, or from plants, or from the liver of the cod, or from anywhere else, that can compare with the fat of milk which is contained in cream. It is probable that there would be no such thing as rickets, which means bad teeth and crooked bones, and many worse things, if all children could get enough cream or even enough good milk. Fortunate are those children who get enough good milk, and still more fortunate if they get cream as well.

THE VALUE OF CREAM AND BUTTER AND OF THE CHEAPER MARGARINE

Failing cream, butter is excellent. That, too, is dear, but much cheaper than cream. It contains about eighty-two parts in a hundred of fat, or, say, twice as much as cream. No other fat is nearly so easily digested, and butter can hardly be too highly praised. If it is cooked, however, the heat is apt to change it partly so that it may upset people. Not only is butter very rich in fat which is very easily digested, but even when very large quantities of it are taken, not so much as one part in two hundred fails to reach the blood.

It is possible to make from animal fats a substance which is very nearly the same as butter. This is oleomargarine. It contains the same proportion of fat as butter, and it is the same fat. In certain other respects it has the advantage of butter, for it keeps better, and cannot so easily become rancid. It is almost as well absorbed as butter. It is, of course, very much cheaper, and the highest English authority says "that there is every reason to wish that the prejudice against it, which is still rather widespread, should quickly disappear, and that it should be welcomed as an admirable and cheap substitute for a rather expensive but necessary food."

HOW CHEESE GIVES STRENGTH TO MUSCLE AND BLOOD AND BRAIN

One other product of milk we must mention, and that is cheese, which, like butter, is made from milk through the action of microbes. We shall see later that microbes have other relations to milk. Cheese is very highly nutritious. A pound of Cheddar cheese represents very nearly the whole of the proteid and most of the fat in a gallon of milk. Beef contains less than half as much nourishment as the same weight of cheese. Of course, cheeses vary considerably in their proportion of food material, and as in the case of fish, and, indeed, of food in general, cost has no relation to value. In the case of food and drink, it is always flavour that is paid for. Careful inquiry leads our best authority to the following conclusion, which, I think, does not need to have any of its words explained: "To the man who wishes to use cheese as a cheap and efficient substitute for meat one would say: Buy Canadian or Dutch, and preferably the former; for in that way you will be getting by far the most nutriment, in other words, the most muscle and blood and brain, for the money you spend."

Large books, of course, have been written about milk and its products as foods, and this is natural enough, as there is no other food that can compare with it. There is only one other point, however, which we have space for here, and that is the value of milk as a food for the nervous system.

WHY BRAIN-WORKERS AND NERVOUS PEOPLE SHOULD USE PLENTY OF MILK

In this respect milk has no rival. The food that comes nearest to it is eggs, and we can understand the place of these two things as foods for nerves, if we understand that from what is in the egg, aided only by heat and oxygen, the brain of the chicken is actually made; while milk is the food prepared for the development of the brain in all those animals that have the highest brains. The health of the whole body depends upon the

brain, which always develops in front of the body, and then helps the body to follow after it. Thus we should expect milk to be specially designed for the benefit of brain-tissue. That is what we find. But brain always retains its importance in the case of human beings, and so, therefore, should milk as a food. For brain-workers, and for nervous persons who suffer from sleeplessness and brain fag and so on, there are no foods like milk and cream; and it may almost be said that milk is the only medicine worth anything in such cases.

All this must be insisted upon because most people have the idea that milk is a food for babies and red meat a proper food for men. But the men who are studying these things—men who want to get the best work out of their minds, or who are training for long-distance races—are beginning to know better. Nothing makes good red blood like white milk, different though their colours be. What makes blood red is iron, and the one food which contains iron in absolutely perfect form for the body to use is milk.

A REALLY IMPORTANT QUESTION THAT PARLIAMENT SHOULD ATTEND TO

The Japanese have hitherto used very little milk, for Japan as a country is very poor, or was until a year or two ago, in animals generally—horses, cattle, sheep, and so on. But the Japanese are aware by their study of modern science that all other foods are second-rate compared with milk. Hitherto there has been very little milk to be had in Japan, and it has been very little used as an article of diet.

Now, not only are the Japanese a rather small and stunted people, but also the proportion of their very small babies that die is enormous. This is not the case, however, with those fed by their mothers. The Japanese are trying to remedy these things, and to strengthen their power as a nation by drinking more milk. We believe in being a strong nation here also, but our legislatures do not pay anything like the attention that they should pay to the really important things. We spend too much time in trying to make good citizens out of boys who did not have enough milk when they were children, boys with bad teeth and crooked bones and narrow chests, and this idea fails, and will always fail. We need good citizens, and we shall always need them, but we need first of all men with healthy bodies—and healthy minds—to make good citizens out of.

THE ANIMAL THAT INVENTED MILK, ON WHICH OUR LIFE DEPENDS

The life and power of all the higher animals, which we call mammals, depends upon milk. It is a pity that we cannot discover exactly what the earliest beginnings of milk were, but we believe it was some branch either of the amphibians or the reptiles that invented this wonderful fluid, and so began the mammalian order. We can at least arrange before our minds all the kinds of mammalian animals now existing, to see whether any general fact is taught us by them. There is such a fact, and a great one.

We find among the lowest mammalian animals, which live in Australia, that milk is of least importance, and is used for the shortest time. But steadily and regularly as we ascend through the mammalian order, we find that the importance of milk increases along the line of real progress; and this means, of course, that the importance of *motherhood* increases.

When we come as far as the man-like apes, we find the longest period, hitherto, during which the young are dependent on milk, if they are to survive at all. If we take the total period during which the life of the young creature depends entirely upon the mother, we find it longer than in any preceding case in the history of the world, and we find also that throughout that time more is demanded of the mother.

THE CHILD IS THE MOST HELPLESS THING IN THE WORLD WITHOUT ITS MOTHER

But though the case of the man-like apes has no parallel before it, it is quite outclassed among ourselves. Here the period of dependence of the young upon their mothers is longer still; the natural period during which the mother nurses her baby has no parallel; Nature makes more demands upon the mother if the child is to survive—that is to say, if the human race is to continue—than she does of any other mother; the human being is at birth more helpless even than the baby ape; and this complete helplessness, for the like of which the whole animal and vegetable world may be searched in vain, is longer

continued than in any other case. Now, milk is the outward and visible expression of a greater thing still, which is motherhood; and the lesson we have to learn, which all those who rule nations have yet to learn, is that by the laws of Nature the importance and need of motherhood increase as life ascends, and that upon it depends the destiny of all living races.

ONE OF THE MOST ASTONISHING FACTS THAT MEN KNOW

We have already learnt that at bottom the needs of living matter are everywhere the same. Nothing is more likely than that, if Nature invents a perfect food for a human baby, that food will be very suitable even for living creatures standing at the other extreme of life—the microbes, about which we have already learnt. This is so, and, indeed, all the substances on which microbes can conveniently be grown are foods of one kind and another. None of them is better than milk as a perfect food for microbes in general. Those who cultivate microbes for study, daily avail themselves of this fact, but it has a very serious side.

All milk contains microbes—not as single spies, but in battalions. If the milk is pure and has been carefully prepared, the microbes it contains are innocent. If the milk has been boiled or treated in various ways, whether by heat or by chemicals, the microbes will all be dead; but in any case they are there. It is one of the most astonishing of recently discovered facts that a sort of working arrangement has been come to between the human body and a particular kind of microbe, of which milk is the natural home. This microbe lives on milk sugar, or lactose, and turns it into lactic acid—the acid of sour milk. This change occurs in part in the stomach. This particular microbe lives naturally in our own bodies, and is very useful there. It prevents, when we are well, the growth of all kinds of microbes that would hurt us.

HOW TO GET PURE MILK AND HOW TO KEEP IT PURE

Many people now take sour milk every day, or actually get strains of this microbe from the druggist and add them to milk in order to preserve or to recover their health. This particular microbe is found in the air, and on every solid object wherever cows are. It is to be found in the purest milk, and doubtless has been found in milk for ages past. During that long time we and it seem to have become adapted to each other. Thus, in course of time the purest milk will turn sour unless the good microbes in it have been killed. Such milk is by no means bad for us; many people like it very much.

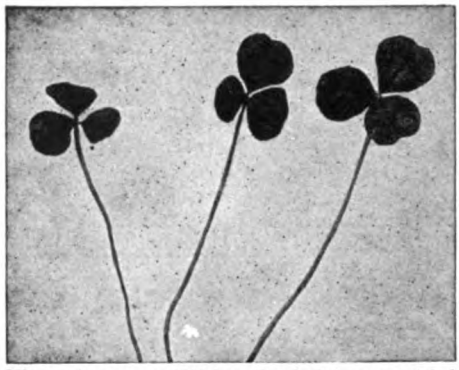
If cows are properly fed, so that no horrible oils get into the milk, and if they are kept clean and have plenty of fresh air and sunlight, so that they do not suffer from the terrible disease called consumption, then we have the first conditions for good milk. This should be milked by clean hands into clean pails, and the hair and clothes of the milker should be covered with some clothing that has been boiled, and the cow itself should be looked after very carefully. The milk in hot weather should then be cooled immediately, and packed into bottles sealed with a clean seal. No milk should ever be allowed to be exposed to the air; indeed, no food of any kind should be allowed to be exposed, but milk least of all.

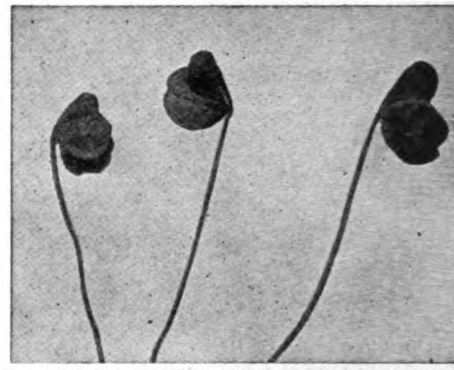
A WICKED THING ABOUT MILK THAT CAN BE STOPPED, AND MUST BE STOPPED

At present, owing to our ignorance and carelessness, milk spreads various forms of consumption everywhere. In the hottest quarter of the year it kills tens of thousands of babies, and it often spreads other diseases, such as typhoid fever, diphtheria, and scarlet fever. These, however, are a mere trifle compared with the enormous massacre yearly caused by milk through carrying consumption from the cow to the human being, and through becoming infected with other evil microbes which kill the babies in our large cities like flies every summer. All this can be stopped any day, and must be stopped. It is certain that, to stop it, milk must become dearer—that is, reckoning in money, not in life, for milk that kills scores of thousands of people every year is dear enough. It almost seems as if the fathers of children would have to smoke one or two fewer cigars every day in order that young America should be fed on pure milk. But, first, we must learn what pure milk is, and how to provide for getting it everywhere.

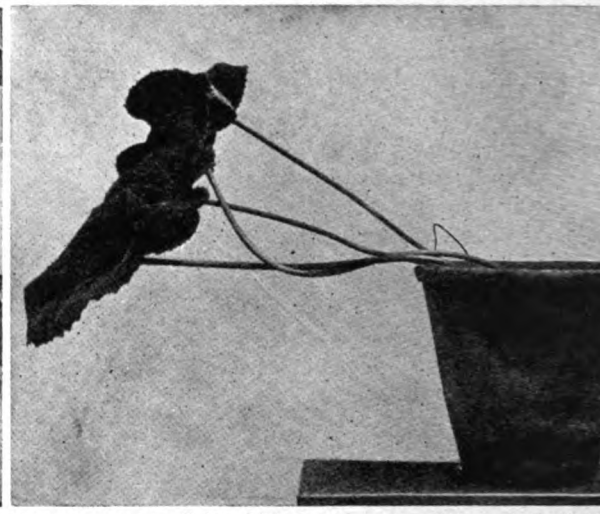
The next part of this is on page 2923.

PLANTS THAT SEE AND PLANTS THAT FEEL

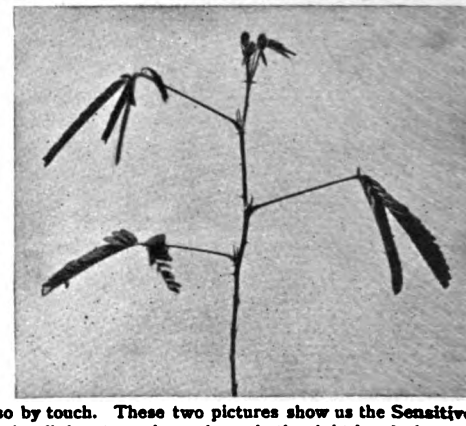




We read on page 1266 how the dark is a great help towards making us sleep, and the darker the room the more soundly we sleep. Plants, too, are very sensitive to light, as these two photographs of clover show. The left-hand picture shows us clover by day, and that on the right shows us the same three leaves closed after sunset, so that they shall not feel the cold of the night. Many other plants go to sleep in this way, by closing their leaves.



In order to grow up strong and healthy, all plants must have light. All leaves turn outwards towards the light, as the photograph on the left shows us. Some are so eager for light that they will move towards it like the plant on the right, which seems eager to stretch itself right out of the window near which it has been placed.



Plants are not only strangely affected by light, but also by touch. These two pictures show us the Sensitive Plant, which is so called because the leaves close up at the slightest touch, as shown in the right-hand picture.

The photographs on this page are by Leonard Bastin, and that on page 2801 by Valentine.

WHAT THE WISE MAN TELLS US

"CAN the flowers see?" "Certainly not," we would answer emphatically; and yet the Wise Man tells us that they do see, many of them having little eyes that are especially sensitive to light and take impressions somewhat like the lenses of a camera. Light, the Wise Man says, is not a thing, but a state of motion or vibration in the ether, or a kind of electricity. "But ether, what is ether?" and the Wise Man answers that question too, for there seems to be nothing that he does not know. He tells us here why it is that we see stars when we get hit in the eyes; why red will irritate a bull to uncontrollable fury; how the forests that turned into coal came to be buried so deep in the earth that the poor miners have to live half their lives in the dark in order to get the fuel that gives us light,—these and many other things he tells us,—but we must read with attention if we wish to remember.

CAN THE FLOWERS SEE?

CONTINUED FROM 2694

WE know now that, though no one would say that plants perceive the images of things as we do with our eyes, yet they certainly can see. Nearly all the leaves of plants are so made that they act as lenses, and it is possible to take photographs by using leaves for the lenses of the camera. The leaves that are best in this respect seem to be those grown in shady places, where light is especially precious. These leaf-lenses have two useful purposes. They seem, in the first place, to concentrate and focus the light that reaches the leaf exactly upon the cells in the leaf which, by the aid of light, feed on the carbonic acid of the air. It seems, in the second place, that the plant's power of seeing, or of knowing the difference between light and darkness, often guides it so that it can turn its leaves at just the angle which will enable them to receive most light. Besides this general power of leaves, it seems that many green plants, if not all, have special points, which have been called *ocelli*, or *little eyes*, that are especially sensitive to light, and are developed for that purpose.

WHAT IS LIGHT MADE OF?

Light is a very real and powerful and precious thing—yet it is not a *thing*, as a chair is a thing; and it is quite correct to say that, in a sense, light is made of nothing. It is not a form of matter, it is not made of any elements or any compounds, there are no atoms in it; and it does not attract matter, nor is it attracted by matter. Light was once thought to be made of something—and by the very greatest man who ever studied it. Sir Isaac Newton thought that light must be made of a number of tiny specks of stuff that struck the eye, or bounced off any bright object, as a ball bounces from a wall. But now we know that light is not a *thing* or a number of things at all, but is a *state* of motion, or strain, or vibration, in the ether. If we may say that light is made of anything, then we must say that it is made of the ether—but the ether in a particular state of what we call wave-motion. If light were *material*—if it were made of matter—it would have to obey the law of gravitation, but we can prove that it does not.

IS LIGHT A KIND OF ELECTRICITY?

We know quite certainly now that light is a kind of electricity—or that electricity is a kind of light; on page 1422 of this book it is explained that the word electricity is most unfortunately used to mean two quite different things. Here we mean

electric waves, like those which pass along a wire in telegraphing or telephoning, or through the air in wireless telegraphy. In all these cases what really travels is a wave in the ether, and light is a wave of the same kind, travelling at the same rate exactly, and subject to the same laws in every way. Only the waves of light are shorter and the number of them that occur in a second is much larger than in the case of the ether. The difference is the same as that between a low note and a high note of sound.

Light, then, is a kind of electricity. The waves of light, of radiant heat, and of electricity, differ from the waves of sound: first, because they travel in the ether, and not in anything material; and, secondly, because they are waves from side to side, and not to and fro in the line of their flight through space.

WHAT IS THE ETHER?

Ether is the chemical name of a sweet-smelling liquid, made of carbon, hydrogen, and oxygen, which, like chloroform, produces a peculiar kind of sleep for surgical operations. But when we speak of *the* ether we mean something utterly different. Of course, we should have two different words for the two things, but we have not. If we understood the ether, we should have the key to almost every puzzle we find in Nature. At present we know very little about it, but we are sure of certain facts. The ether is *everywhere*. We cannot believe that there is any gap or space or crack in it. It cannot be seen, yet we may say that we see nothing else, for light is a state of the ether, and light is the only thing we can see.

The ether has no weight, yet it is the cause of weight, in a sense, for weight is due to gravitation, and it is through the ether that gravitation acts. And we believe that matter is really made of the ether—that "the electric" particles, or electrons, of which the atoms of matter are composed, themselves consist of things in the ether which we can only dimly picture to ourselves as knots or lumps of ether.

Yet, though we do not know how, there is now really no doubt that the ether is the universal mother of all matter, and of all material things; it is the element of elements, and we cannot pierce behind it to anything, but to the Author of all that is.

WHAT MAKES US SEE LIGHTS WHEN WE GET A BLOW ON THE EYE?

This depends on a very wonderful law about the nerves of the senses, that was discovered by a great German called Müller about the middle of last century. It is that special nerves which belong to the various senses, the nerves of hearing, the nerves of smell, the nerves of vision, and so on, are bound to give us a sensation of hearing or smell or vision if they give us anything. As a rule, the particular nerve is only affected by the special thing it is meant for—the eye-nerve by light or the ear-nerve by sound. But if something has the power at all of affecting the nerve, then we shall seem to see or hear, whatever the thing that excites the nerves really is. Thus a blow on the eye may affect the eye-nerve, and if the eye-nerve is affected we are bound to get a sensation of light. The best proof of this great law of Müller is furnished by electricity. We have no special sense for electricity, as we have the ear for sound or the eye for light; but, if properly applied, electricity is capable of affecting, or stimulating, which is the proper word, any nerve in the body. So, with the electric current you may affect the nose, and the person smells; the eye, and he sees; the ear, and he hears; the tongue, and he tastes; the skin, and he has the sense of touch. We now know how to explain this law. It is not that the nerve of the eye is different from the nerve of the ear, but that it goes to a special part of the brain. Each part of the brain that is concerned in the sensation *is specialised*, or made special—that is, it can only do one thing. The different parts are like the notes of a piano, each of which gives out only the sound natural to it, and no other.

HOW DID THE FORESTS THAT TURNED TO COAL COME TO BE BURIED?

All the earth that covers the great coal deposits of the earth's crust, called the carboniferous, which means carbon-bearing, was laid there through long ages by the sea. Nothing is more certain than that, over every part of what we call the dry land, the sea has rolled for many ages. Probably most

parts of the earth's surface have many times been under water and many times above it. Wherever the sea is, there its water slowly deposits an ever-deepening layer of substances which it has dissolved from the rocks, and other materials which the rivers have brought to it, and yet others which are the remains of creatures living in the depths of the sea.

Then, as the waters roll elsewhere, and the bottom of the sea is uncovered, the surface of these deposits becomes the surface of the dry land. If we carefully study the rate at which the waters are forming deposits to-day, we can get some very rough idea of the time that has passed since various layers of the earth's crust were on the surface, as every layer of it has at some time been; and so we can guess that many millions of years must have elapsed since the coal measures were alive.

ARE WE CREATING NEW DISEASES?

I believe that the answer to this most important question is "No." It is not easy to answer, because we know really very little about the diseases our ancestors died of; but the more we learn by reading the old authors, by studying skeletons and mummies, and so on, the more certain are we that our ancestors suffered from our diseases, and even from other diseases that we have not.

Our cities, with their terrible overcrowding, may mean that diseases spread very easily, but these diseases are not new ones. Dirt makes disease, but our ancestors were ever so much dirtier than we are. They had no such supplies of pure water as our towns have; they drank very impure water, they had no drainage, and they lived in perpetual smells. We find proof that the diseases which are most deadly to-day, like consumption, were well known and terribly common 2,000 and even 5,000 years ago. If we create any new diseases, they can only be diseases of the mind, due to the foolish and unnatural lives that many of us live; but doubtless, when any of our ancestors lived these foolish lives, they suffered as we do.

DO DISEASES EVER DISAPPEAR?

Yes, indeed they do, and it is a good thing, too. There was a time when England was cursed with a very terrible disease which has its real home in China, and is called the plague. There is now no plague in England, though it would soon come back if a careful watch were not kept for it at every port, and if every case that comes to London or Liverpool or Glasgow were not at once kept apart, so that the plague does not spread. There was once leprosy all over England, and the poor lepers were imprisoned in great places. There is now no leprosy in England, and has not been for many years, except a few persons who have got it abroad, and have come to live in England. Smallpox, too, has almost disappeared in England, and in Germany it is practically unknown, for in Germany the great discovery of vaccination by the Englishman Jenner is properly appreciated by the nation and is employed generally.

Then, in some parts of the world, where diseases like malaria and yellow fever have raged for ages, they have lately disappeared, because the insects that carried them have all been killed. And just now a terrible disease, called Malta fever, is being made to disappear from Malta, as we have learned that it is carried in goat's milk, and now no soldier or sailor in Malta is allowed to drink goat's milk, and so they do not suffer from the disease.

ARE WE HEALTHIER THAN OUR ANCESTORS?

Certainly we are—far healthier. The death-rate has been falling all over the United States for many years. We know at what ages our ancestors commonly died—even those who had most wealth and knowledge. We know that, long ago, the children of the kings and queens died at much the same rate as the children of the slums do nowadays. We know hideous diseases which raged in America and are now unknown, or very rare. Only a generation ago, for instance, typhus fever was very common, and now it hardly causes ten deaths in the whole of America in a year, though the disease is still sadly common in some very poor countries.

Nothing is more foolish or stupid than to talk of the "good old days," as if everyone had been happy, and wise, and strong, long ago. The more we learn of the "good old days," the more we learn how bad they were, and how much better off we are now; though our children's children will think we were bad enough, when they have abolished

consumption and other terrible diseases which we could abolish at any time if only we were wise enough.

WHAT CAUSES CONSUMPTION?

Consumption is caused by a microbe, which was discovered in Germany twenty-eight years ago. We catch it from each other, and from the milk—and occasionally the flesh—of cows, which suffer from it just as we do if they are kept in badly ventilated places. The disease is now diminishing in America, England, France, and Germany, and will go on diminishing the more we act on our knowledge of its cause. They do this best in Germany, and consumption is decreasing much more rapidly there than it is here. We are just beginning here to protect ourselves from the milk of consumptive cows, to punish people for spitting in trains and street cars, and to learn to keep our bedroom windows open. When you who are children, and who read this now, have grown up to be men and women, consumption will probably be as rare as typhus fever is to-day.

The children of to-day will be the grown-up people who govern America and vote for members of Congress in a few years to come; and the next generation will learn that the health of the people is the best possession of a nation, and will know how to obtain it. The children of to-day, and even more their children, will look back on us, who allowed ourselves to be killed by consumption at the rate of about one in seven of all deaths—and they will not talk of the "good old days."

WHY DOES RED IRRITATE A BULL?

It is very difficult to be quite sure of the truth of this question, and we ought really to be sure of the fact before we try to explain it. No one has made experiments to prove that red really irritates the bull more than any other bright colour. Still, it is probable that red, perhaps just because it is usually the brightest of colours, does irritate a bull; though if the red colour were on something that did not move, perhaps it would have much less effect. People have thought that bulls are irritated by red because it is the colour of blood; but I do not think that is so. A certain amount of study of human beings seems to suggest that different colours differ in their effect on the nervous system, and that while such colours as green and violet are soothing, yellow and red are exciting. Of course, it takes very little to irritate a bull, and a red rag is by no means necessary; only the saying is so popular, perhaps because it applies so well to ourselves. We are all apt to fire up at some particular subject, as the bull is supposed to do at a red rag.

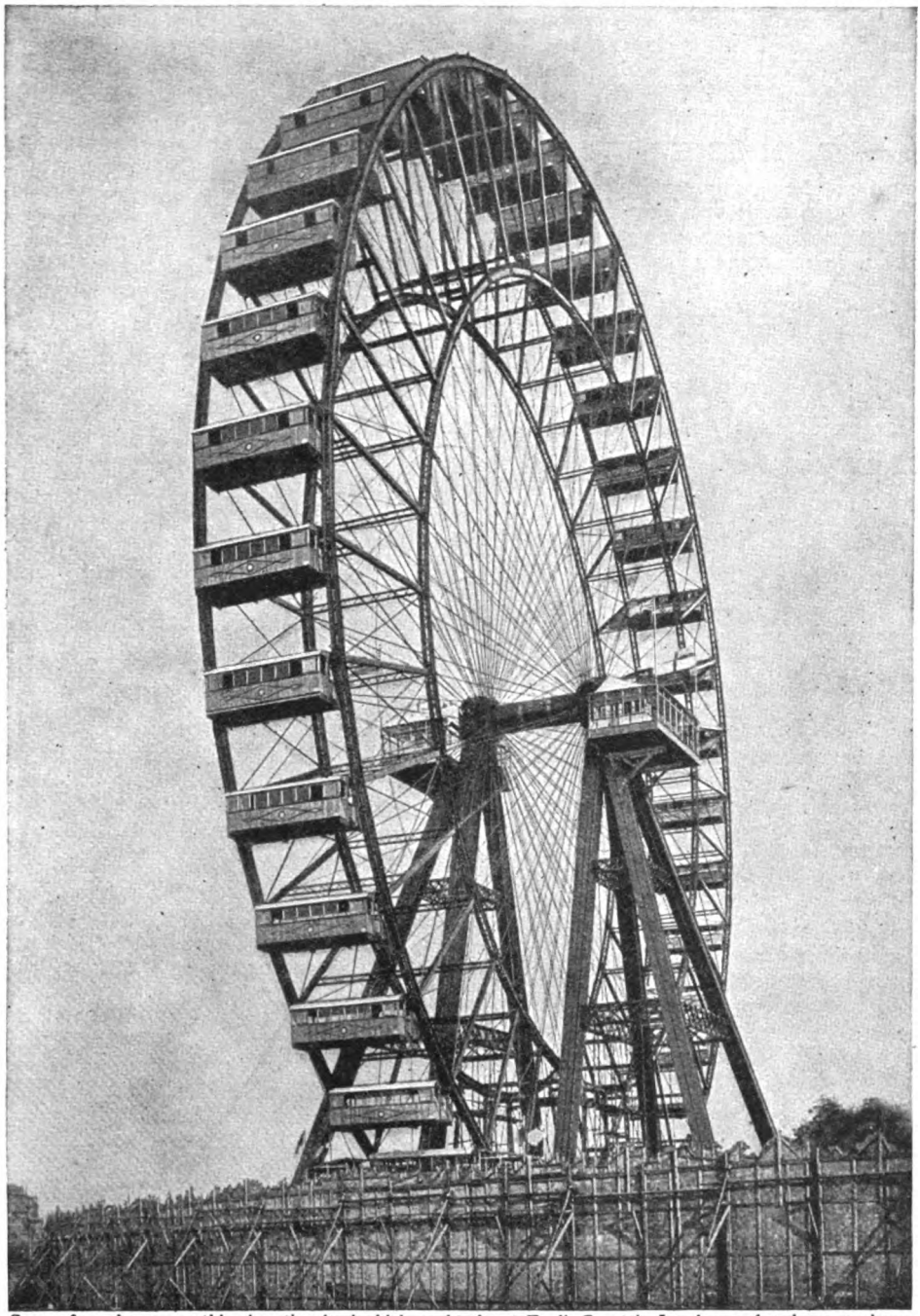
DOES THIS EARTH LOOK LIKE A STAR TO OTHER PLANETS?

Our earth must be a very brilliant object in the sky. Seen from the distance of the moon, it would be magnificent, though, like the moon, shining entirely by borrowed light. To an inhabitant of Mars, if he exists, the earth will probably look much brighter and larger than Mars looks to us, since the earth is much larger than Mars, and much nearer the sun, so that it is proportionately brighter, according to the "law of inverse squares," explained on page 2504. But there is a very striking fact about the earth, as it must appear to all the planets, from Mars outwards, that are farther than we are from the sun. As the earth lies between them and the sun, the portion of the earth's surface that they can see illuminated must change, and be always changing; for exactly the same reason as we notice in the case of the moon. When the earth is just between Mars and the sun, she must be invisible from Mars, because the shining side of her is turned away from Mars. This must also be true of the appearance of the earth as seen from any planet still farther than Mars. To the other planets the earth will be recognised as a planet, and not a star—if they have inhabitants who possess intelligence—because she will be seen to wander through the sky, as the other planets, or wanderers, are seen to do from the earth.

WHY IS VENUS BRIGHTER AT SOME TIMES THAN AT OTHERS?

The principal answer to this question can be guessed by anyone who has read the answer to the last question. Venus is nearer to the sun than we are, and therefore Venus must have phases like the moon—times when she is full, times when she appears as a crescent, and so on. That this is so was one of the many wonderful discoveries made by Galileo, when he perfected his telescope. I wonder what lovers of Nature would

A WHEEL A QUARTER OF A MILE ROUND



Some of you have seen this gigantic wheel which used to be at Earl's Court in London, and perhaps you have gone round in the cars. This was not the first great wheel to be built. An American engineer, Mr. G. W. Ferris, had seen those curious little upright roundabouts that come to the country fairs, and he thought out **the idea and built for the World's Fair at Chicago a big wheel of iron that carried 1,440 people at one time. Then the Earl's Court wheel was built, and this was much more wonderful than the other. It was 300 feet across, and the towers that supported it were 175 feet high. The axle, weighing 54 tons, was hollow, and people could walk through it from one side to the other while the wheel was going round with its 1,600 passengers. The great wheel was turned by a big engine that needed only one man to work it.**

give nowadays for a new instrument of such power as the telescope has, and the first chance of using it! Galileo had scarcely to do more than put his "spy-glass" to his eye, in order to discover the spots on the sun, the craters of the moon, four of the moons of Jupiter, the phases of Venus, and the rings of Saturn! He did not dare to announce his discovery about Venus in an open way; but, of course, he wished to place the fact on record, so he wrote an acrostic, in which was hidden the statement that Venus has phases like the moon. It needs only a quite small glass, such as Galileo's was, to see the disc of Venus, and so to find that it changes just as the moon does—though, naturally, at a very different rate. I am writing in September, and just now the illuminated portion of Venus is between four-tenths and five-tenths of its disc so it is nearly "half-Venus."

Of course, all the other planets, except Mercury, are always seen by us on their lit side, as they are farther away from the sun than we are. Mercury is so small and difficult to see, owing to its nearness to the sun, that it would be very difficult indeed to make out its phases.

WHAT IS THE DIFFERENCE BETWEEN FAT AND OIL?

Oil is a misleading word, for it is used in two senses. We call the things that give plants their smell, such as turpentine, oils, but they are quite different from other oils, and we should always call them *volatile oils*, which means flying oils, because they readily fly into the air in the form of a gas. If you put a drop of such an oil on a piece of paper, it soon disappears; but if you put a drop of any of the other kind of oils, such as melted butter, on a piece of paper, it makes a mark which stays. So these oils are called *fixed oils*, and the simple thing to remember is that fixed oils and fats are really the same thing. When it is solid we call it fat; when liquid, we call it oil. A fixed oil is melted fat, and fat is a fixed oil that has turned solid. Every fat has a melting-point, as we call it, when it is so warm that it melts and turns into oil; or we might say that every fixed oil has a freezing-point, when it is so cool that it solidifies and turns into fat.

Now, it is a very interesting thing about the fat of our bodies that its melting-point is just the temperature of the blood. So the fat of our bodies is always just at a point where it is neither quite solid nor quite liquid; and this is just the state of it that suits us best. If it were quite solid, then the blood could not easily help itself to it as it was needed; and if it were quite liquid, it would not stay in one place. There are hundreds of different fats and oils and mixtures of them, and they all have their own particular melting-point, above which they are liquid oils, and below which they are solid fats.

WHAT DO WE MEAN BY TRADITION?

When knowledge of any kind is handed down from father to son, we say that it is tradition, which really means *giving across*. Tradition may be given across by word of mouth, or, in later stages of civilisation, by books.

It is one of the most unfortunate things in the history of the world that tradition so very often gets lost, as in the case of the Pyramids, for instance. Probably tradition is quite safe so long as a particular civilisation persists, but it is always seriously endangered when one nation is conquered by another. For one thing, books and inscribed stones and walls are destroyed by the soldiers when cities are captured, and so all the traditional knowledge which they contain is lost to the world.

HOW IS IT THAT KNOWLEDGE CAN EVER DIE OUT?

As for tradition from parents to children, when a nation is conquered, many parents are killed, and children are carried off to other parts, or, at any rate, are separated from their parents. In olden times almost every grown man of a conquered nation was either killed or enslaved, and so lost his children, and his traditional knowledge died with him. This may have happened in the case of the Pyramids, and it is quite possible that full accounts of how they were built were contained in the great library of Alexandria, and were lost when that library was burned. The really wonderful thing about our knowledge of olden times is how learned men manage to find out about the remote past by digging up and interpreting bits of inscriptions on stone in languages which, at first, no one can find the key to.

The next Questions begin on page 2873.

A GIRL'S DESPERATE RIDE

CONTINUED FROM 2734

SIR JOHN COCHRANE had been condemned to die, and was shut up in the Tolbooth prison in Edinburgh, seen in the picture. He wished his sons and daughter to refrain from visiting him, for he had joined in Argyle's insurrection against the new king, James II., and thought if his children came to see him they might lay themselves open to suspicion. But one day he had a visit from his daughter Grizel.

Father and daughter felt very sad indeed, for only one glimmer of light could they see. Sir John's father had written an appeal for pardon to the king's confessor, who had great influence over the bigoted monarch. But time was pressing. The journey south to London took days to perform, and if the pardon did not come soon, Sir John must die. Even then the warrant must be on its way to Edinburgh.

While talking over the desperate situation, an idea came into Grizel's mind, and she determined to carry it out without delay.

Early on the next day she rode south. First, she called at the cottage of her old nurse, borrowed her foster-brother's clothes, and then rode on to meet the messenger. She discovered the inn where he was staying, and entered the room where the man lay asleep, exhausted by his journey. But he was lying on the mail-bag, and she dared not attempt to draw it away from under him. She quietly withdrew the charges in his pistol, and, mounting her horse, rode off. Before she had gone far from the inn, she halted and waited for the messenger.

When the man rode up, she was ready for him. She greeted him pleasantly, and rode alongside and chatted with him. Then, sure of her ground, she quietly told him that she must have his bag. The man at first thought the youth, as she appeared to be, was joking, but he grew angry at her persistence, and when she aimed her pistol at him, fired his at her. But, to his surprise, it failed to go off, for the charge had been withdrawn.

His second pistol proved equally useless. He dismounted and rushed at his assailant, but the girl, quick as lightning, seized his horse and galloped away with it; for was not the precious mail-bag attached to the saddle? Fast and furiously she rode, until she reached a wood where it was safe to open the bag. Having taken out the warrant, she galloped off to her old nurse's cottage, changed her clothing, and rode back to Edinburgh.

The non-delivery of the death-warrant caused a delay which allowed time for the king to consider the offer of a bribe from Sir John's father. This he accepted, and so Sir John was saved.

AN APRONFUL OF GUNPOWDER

THIS story of Elizabeth Zane is one of those precious tales of the heroism of our great-grandmothers which we cannot forget. Her father was the leading man in his section of the Ohio wilderness and commanded the little fort built for defence against the British and their savage allies. Though there were not great battles after the surrender of Cornwallis in 1781, peace did not come to the West until years afterward.

It was an autumn day in the year 1782. Evening was slowly closing in about the little log fort. The handful of men and women within the palisades watched the descent of the sun with anxious hearts, for, in the deepening shadows of the forest beyond the clearing, Indians were hiding, watching every moment of the besieged, and ready at any moment to rush in and finish the business. No one in the little fort knew what deviltry the night might bring forth.

Moreover, a terrible calamity had fallen upon the garrison. They were out of powder. The men, pacing restlessly about the stockade, glanced every now and then from their empty pouches to the little group of women and children that held all most dear to them in the world, and from that out over the stockade to a little hut in the clearing. Then they swore softly to themselves.

Almost under the stockade walls in that little log hut there was an abundant supply of powder, which by some oversight had not been brought inside the fort. Two or three brave men were there, too, to defend the powder, but they were thirty yards away. In every inch of that distance death lurked from the hands of the savages watching in the shadows of the trees.

The men gathered together to talk the situation over. At last one thing was decided. They must have a keg of powder — and at once! Several of the young men eagerly offered to get it; but from the little handful no one could well be spared from his post upon the stockade, and the shadows lengthened as they talked.

Suddenly a girl's crisp, clear voice broke in upon their conference. It was the young daughter of the commander, Elizabeth Zane.

"I have heard you talking," she began decisively, "and I do not think any of your plans are any good. *I* am going for the powder."

A murmur of quick protest broke from the men.

"No," they growled, "it's a man's deed."

"Yes," returned Elizabeth calmly, "but there isn't a man who can be spared. A woman will never be missed in the defence of the fort."

Zane had been regarding his daughter thoughtfully under knit shaggy brows.

"The girl is right," he said at last gruffly in his effort to control his feeling. "Let her go."

Through the gathering shadows Elizabeth stole out of the stockade door. The anxious watchers behind the palisades saw the slim figure dart across the dusky clearing to the hut. For a moment the girl beat upon the door with white, uplifted hands. Then it was opened and she slipped within. Almost by a miracle she had reached the outpost without being discovered by the foe.

It seemed hours — though it could have been but a few minutes — before there were any signs of the door opening. Then it was pushed apart a little way and Elizabeth appeared. She seemed to be holding her checkered apron, full of something, gathered to her breast. Over the stubble field she came on flying feet. Suddenly the men in the fort gripped their useless muskets.

A wild, horrible whoop quivered through the night air. Elizabeth had been discovered. A rain of arrows and bullets flew about the little, running figure, and some shrieking savages broke from the woods in full pursuit. Once the girl almost fell. Her father hid his face in his hands. Oh! why in God's name had they planted that field with corn in the springtime? No, she is up — her brave, little feet carrying her on — the precious bundle still clasped to her

breast. She has almost reached the stockade. Open the door — quick! Strong, swift arms gather her into the fort, and slam the door, — just in time, for a pelting shower of bullets rattle upon the logs.

But who cares about bullets now? The fort is saved — for in that checkered apron gathered in Elizabeth's arms is the gunpowder that will enable them to drive away the enemy and hold the fort until help comes.

IN LAKE MICHIGAN AT MIDNIGHT

THE newspapers often contain accounts of heroic acts. The journals of August, 1906, tell the story of a brave deed by a young fellow of nineteen, one Edwin A. Crolius.

He, with four other young men, were out on a pleasure trip in a small sailing yacht on Lake Michigan. Toward night they were caught in a squall, and, after a brave fight with the wind and waves, their boat was capsized. With great difficulty, all five managed to find the overturned yacht in the darkness. For hours they clung to her, vainly hoping that some vessel would come within hailing distance, while the chill, slanting rain beat down upon them and the boat lurched and plunged in the heaving sea. Hour after hour passed, but no help came.

Once they fancied they saw a light from one of the lake schooners, and shouted into the darkness, but the rain beat the cry out of their mouths, and the light disappeared into the night. As the night passed they drifted a little toward the south, and gradually they were able to make out the misty stretch of light through the rain that told that Chicago was perhaps not more than two miles away.

Only two miles! Yet the young men were not good swimmers, and they dared not attempt to swim through the darkness, chilled and stiff as they were from hanging to the yacht for hours in the water.

The faint sound of bells tolling the midnight hour came dismally through the beating rain; and it was decided that something must be done at once, for two of their number were already shaking with the cold. Crolius, the youngest of the party but the best swimmer, volunteered to swim to Chicago and secure aid. His comrades tried to dissuade him from the dangerous undertaking, but the brave young fellow replied that it was a case where one must risk death or all five would perish, and courageously set out to battle his way through the waves. After an hour of exhausting struggle against the elements, he managed to reach Chicago, and secured an immediate rescue party for his companions, who were brought safely to land. Although much exhausted, the little party suffered no ill effects from their adventure.

A BRAVE WOMAN

IN another part of our book we have told about the Carnegie Hero Fund Commission. Among the people who have received its medals for heroism is a woman, Marie B. Langdon. Through the bitter cold of a midwinter night, Mrs. Langdon, without snowshoes, went a long distance from her home, on hearing cries for help, and met a woman neighbour with her children, who had fled from their burning home. Mrs. Langdon relieved the woman of her baby and carried it back through the blinding snow to her home, followed by the mother, who was completely exhausted. Then Mrs. Langdon struggled back in the teeth of the storm for three-quarters of a mile, where she found the older child, whom they had been compelled to abandon. Removing her outer skirt, the big-hearted woman wrapped it around the child and started once more for home. On and on she beat her way, but the child grew heavier and heavier, and the blinding whirl of the snow confused her until she sank upon the ground. To her horror she discovered that the child was dead. The cold seemed closing in about her limbs, and for a moment she almost lost consciousness. Then realising her danger, by a strong effort of will she regained her senses, and laying the child gently in the snow, she managed to battle her way through the night back to her own home.

THE BRAVE CONSTABLE OF FRANCE

DU GUESCLIN is a name honoured by the French, for he was the hero of their country in the warlike Middle Ages, and French boys and girls delight in stories of what he did and said.

Bertrand du Guesclin was born between 1314 and 1320 in a castle in Brittany, and as a boy he cannot have been a very agreeable playmate—for he was obstinate, sullen, quarrelsome, and ever ready to fight. An old chronicler says he was the ugliest boy between Rennes and Dinant, roamed about with peasant boys, and could not be taught to read. It cannot be denied that he was headstrong and restless. At sixteen he ran away from home.

But for all his troublesome ways, the boy had in him the making of a great and clever general. He became a strong man, a brave soldier, a devoted patriot, and a defender of his country, a foe worthy of the Black Prince, so that his countrymen used to boast that they possessed the bravest general in Europe. Du Guesclin fought first in the War of Succession in Brittany, and then attracted the attention of his king, Charles V., who saw in him the very leader needed to drive the English out of France. After the Treaty of Bretigny, the free-lances, who were soldiers paid to fight for others, were disbanded and wandered about, plundering and slaying the inhabitants. The country was in a dreadful state, so King Charles bade Du Guesclin rid the land of these robber soldiers. Then the Breton gathered these dreadful robber bands together and led them in an expedition against Pedro, the cruel King of Castile. This monarch was ruling so badly that one of his half-brothers had come to beg King Charles's aid in turning him off the throne.

THE GREAT BERTRAND

Du Guesclin was successful; but when the Black Prince was sent by Edward III. of England to help the defeated Pedro, some robber soldiers went back to the side of their favourite leader, the Black Prince, so that Du Guesclin was defeated and captured at the battle of Navaretta, near the Ebro, in 1367. He was taken a prisoner to Bordeaux, where he soon grew tired of the irksome captivity.

There is a story about the Black Prince meeting Du Guesclin in the town, and going up to him and saying:

"How do you do, Bertrand?"

"Well," replied Du Guesclin, "for they say I am the greatest knight in all the world, since you dare not allow me to be ransomed."

Nettled at this, the English prince begged the prisoner to fix his ransom.

"A hundred thousand livres," replied Du Guesclin.

This was an immense sum for those times; so the Black Prince asked in astonishment where he could get all that money. The reply was: "There is not a spinner in France who would not spin a distaff full, to pay for my ransom."

The French people did soon ransom him, and Charles made Du Guesclin the Constable of France. The Black Prince died, and gradually Du Guesclin freed his native land. When Du Guesclin was besieging a castle in Languedoc, the English governor promised to surrender it on a certain day if he were not relieved before. But Du Guesclin fell ill, and died before the day appointed for surrender, so that he could not take the castle. The English governor, however, refused to dishonour his word, but marched with his garrison to the enemy's camp, and laid the keys of the castle on the bier of the dead hero.

Du Guesclin's last words were: "Never forget that, wherever you wage war, the clergy, the women, the children, and the poor are not your enemies." And this was the humane principle that the brave and chivalrous warrior followed out in all his campaigns and battles.

The next Golden Deeds are on page 2951.

The photograph of the Tolbooth, Edinburgh, on page 2805, is by Valentine.

THE NORMAN BARON

IN this fine poem by Henry W. Longfellow, our great American poet has taken a subject from the history of England in the early Middle Ages. He was very fond of choosing themes from English history, for, of course, an American poet has fewer incidents to choose from in American history, and must look to the old land of legend and romance for inspiring subjects of song. Longfellow prefixes to his poem a passage from a French history of the Conquest of England, which may be translated thus: "In those moments of life when the thoughts of man become more calm and deepen, and the voice of selfishness speaks less strongly than the voice of reason, when overcome by domestic sorrow, by illness, or under the shadow of death, the barons sometimes repented of having enslaved the people, and felt they had done a thing displeasing to God, who had created all men in His image." The poet, perhaps, over-praises the Norman baron's death-bed repentance, though it was certainly a case of "better late than never."

CONTINUED FROM 2725

In his chamber, weak and dying,
Was the Norman baron lying;
Loud, without, the tempest thundered,
And the castle turret shook.

In this fight was Death the gainer,
Spite of vassal and retainer,
And the lands his sires had plundered,
Written in the Domesday Book.

By his bed a monk was seated,
Who in humble voice repeated
Many a prayer and paternoster,
From the missal on his knee.

And, amid the tempest pealing,
Sounds of bells come faintly stealing,
Bells that, from the neighbouring cloister,
Rang for the Nativity.

In the hall, the serf and vassal
Held, that night, their Christmas wassail;
Many a carol, old and saintly,
Sang the minstrels and the waits.

And so loud these Saxon gleemen
Sang to slaves the songs of freemen,
That the storm was heard but faintly,
Knocking at the castle gates.

Till at length the lays they chaunted
Reached the chamber terror-haunted,
Where the monk, with accents holy,
Whispered at the baron's ear.

Tears upon his eyelids glistened,
As he paused awhile and listened,
And the dying baron slowly
Turned his weary head to hear.

"Wassail for the kingly stranger
Born and cradled in a manger!
King, like David, priest, like Aaron,
Christ is born to set us free!"

And the lightning showed the sainted
Figures on the casement painted,
And exclaimed the shuddering baron,
"Miserere, Domine!"

In that hour of deep contrition,
He beheld, with clearer vision,
Through all outward show and fashion,
Justice, the Avenger, rise.

All the pomp of earth had vanished,
Falsehood and deceit were banished,
Reason spoke more loud than passion,
And the truth wore no disguise.

Every vassal of his banner,
Every serf born to his manor,
All those wronged and wretched creatures,
By his hand were freed again.

And, as on the sacred missal
He recorded their dismissal,
Death relaxed his iron features,
And the monk replied, "Amen!"

Many centuries have been numbered
Since in death the baron slumbered
By the convent's sculptured portal,
Mingling with the common dust.

But the good deed, through the ages
Living in historic pages,
Brighter glows and gleams immortal,
Unconsumed by moth or rust.

THE SONG OF THE SHIRT

Thomas Hood, one of the most lovable of English poets, was equally great in comic and serious verse. We have already read three of his poems in our book, and that given here is one that will never be forgotten. Only a powerful poet whose heart had bled for the poor and oppressed could have written these moving and burning verses. It is well to remember in reading them that their author could make us laugh as few other poets have ever done, and that it is usually those who see the comic side of life that can best understand and express its serious and tender side.

With fingers weary and worn,
With eyelids heavy and red,
A woman sat, in unwomanly rags,
Plying her needle and thread—
Stitch—stitch—stitch!
In poverty, hunger, and dirt,
And still with a voice of dolorous pitch
She sang the "Song of the Shirt!"

"Work—work—work!
While the cock is crowing aloof;
And work—work—work
Till the stars shine through the roof!
It's oh! to be a slave
Along with the barbarous Turk,
Where woman has never a soul to save
If this is Christian work!

"Work—work—work!
Till the brain begins to swim;
Work—work—work
Till the eyes are heavy and dim!
Seam, and gusset, and band—
Band, and gusset, and seam—
Till over the buttons I fall asleep
And sew them on in a dream!

"Oh, men with sisters dear!
Oh, men with mothers and wives!
It is not linen you're wearing out,
But human creatures' lives!
Stitch—stitch—stitch,
In poverty, hunger, and dirt,
Sewing at once with a double thread
A shroud as well as a shirt.

"But why do I talk of Death?
That phantom of grisly bone,
I hardly fear his terrible shape,
It seems so like my own—
It seems so like my own,
Because of the fasts I keep;
O God! that bread should be so dear,
And flesh and blood so cheap!

"Work—work—work!
My labour never flags;
And what are its wages? A bed of straw,
A crust of bread—and rags.
That shattered roof, and this naked floor,
A table, a broken chair—
And a wall so blank, my shadow I thank
For sometimes falling there.

"Work—work—work!
From weary chime to chime,
Work—work—work
As prisoners work for crime!
Band, and gusset, and seam—
Seam, and gusset and band—
Till the heart is sick, and the brain benumbed,
As well as the weary hand.

"Work—work—work!
In the dull December light,
And work—work—work
When the weather is warm and bright;
While underneath the eaves
The brooding swallows cling,
As if to show me their sunny backs,
And twit me with the spring.

"Oh! but to breathe the breath
Of the cowslip and primrose sweet—
With the sky above my head,
And the grass beneath my feet!
For only one short hour
To feel as I used to feel,
Before I knew the woes of want
And the walk that costs a meal!

"Oh! but for one short hour!
A respite however brief!
No blessed leisure for love or hope,
But only time for grief!
A little weeping would ease my heart;
But in their briny bed
My tears must stop, for every drop
Hinders needle and thread!"

With fingers weary and worn,
With eyelids heavy and red,
A woman sat, in unwomanly rags,
Plying her needle and thread—
Stitch—stitch—stitch!
In poverty, hunger, and dirt,
And still with a voice of dolorous pitch,—
Would that its tone could reach the rich!
She sang this "Song of the Shirt!"

THE ANGELS' WHISPER

Samuel Lover, born in Dublin, February 24, 1797, and died July 6, 1868, was a celebrated Irishman who did many things well. He began life as an artist, wrote two famous novels, some plays, many charming songs, and was a successful entertainer. This is one of his best-known songs, and even young readers will at once recognise the melody of its verse and the tender feeling it so beautifully expresses.

A baby was sleeping,
Its mother was weeping,
For her husband was far on the wild raging sea;
And the tempest was swelling
Round the fisherman's dwelling,
And she cried: "Dermot, darling, oh, come back to me!"

Her beads while she numbered
The baby still slumbered,
And smiled in her face as she bended her knee.
"Oh, blessed be that warning,
My child, thy sleep adorning,
For I know that the angels are whispering with thee.

"And while they are keeping
Bright watch o'er thy sleeping,
Oh, pray to them softly, my baby, with me,
And say thou wouldst rather
They'd watch o'er thy father,
For I know that the angels are whispering with thee."

The dawn of the morning
Saw Dermot returning,
And the wife wept with joy her babe's father to see,
And closely caressing
Her child, with a blessing,
Said: "I knew that the angels were whispering with thee."

THE LAY OF THE LAST MINSTREL

This is another and very familiar example of Sir Walter Scott's romantic poetry. The scene of the story is the borderland between England and Scotland, where Sir Walter lived, and whose legends he loved to relate. The words of the minstrel's own song are not given here. The minstrel of the past was one of the many picturesque figures that vanished with the changing ages, and we fear that the wandering singers and musicians of our own time are poor substitutes for him.

THE way was long, the wind was cold;
The Minstrel was infirm and old;
His withered cheek, and tresses grey,
Seemed to have known a better day;
The harp, his sole remaining joy,
Was carried by an orphan boy.
The last of all the bards was he,
Who sung of Border chivalry;
For, well-a-day! their date was fled;
His tuneful brethren all were dead;
And he, neglected and oppressed,
Wished to be with them, and at rest.

No more, on prancing palfrey borne,
He carolled, light as lark at morn;
No longer courted and caressed,
High placed in hall, a welcome guest,
He poured to lord and lady gay
The unpremeditated lay.
Old times are changed, old manners gone,
A stranger filled the Stuart's throne;
The bigots of the iron time
Had called his harmless act a crime;
A wandering harper, scorned, and poor,
He begged his bread from door to door,
And tuned, to please a peasant's ear,
The harp a king had loved to hear.

He passed where Newark's stately tower
Looks out from Yarrow's birchen bower;
The Minstrel gazed with wistful eye;
No humbler resting-place was nigh.
With hesitating step, at last,
The embattled portal-arch he passed,
Whose ponderous grate and massy bar
Had oft rolled back the tide of war;
But never closed the iron door
Against the desolate and poor.
The duchess marked his weary pace,
His timid mien and reverend face,
And bade her page the menials tell,
That they should tend the old man well;
For she had known adversity,
Though born in such a high degree;
In pride of power, in beauty's bloom
Had wept o'er Monmouth's bloody tomb!

When kindness had his wants supplied,
And the old man was gratified,
Began to rise his minstrel pride:
And he began to talk anon,
Of good Earl Francis, dead and gone,
And of Earl Walter—rest him God!—
A braver ne'er to battle rode:
And how full many a tale he knew
Of the old warriors of Buccleuch;
And would the noble duchess deign
To listen to an old man's strain,
Though stiff his hand, his voice though weak,
He thought e'en yet, the sooth to speak,
That, if she loved the harp to hear,
He could make music to her ear.

The humble boon was soon obtained;
The aged Minstrel audience gained.
But, when he reached the room of state,
Where she with all her ladies sate,
Perchance he wished his boon denied;
For, when to tune his harp he tried,
His trembling hand had lost the ease
Which marks security to please;
And scenes, long past, of joy and pain,
Came wildering o'er his aged brain,
He tried to tune his harp in vain.
The pitying duchess praised its chime,
And gave him heart, and gave him time,
Till every string's according glee
Was blended into harmony.
And then, he said, he would full fain
He could recall an ancient strain,
He never thought to sing again;
It was not framed for village churls,
But for high dames and mighty earls;
He had played it to King Charles the Good,
When he kept court in Holyrood;
And much he wished, yet feared to try,
The long-forgotten melody.

Amid the strings his fingers strayed,
And an uncertain warbling made;
And oft he shook his hoary head.
But when he caught the measure wild
The old man raised his face and smiled;
And lightened up his faded eye
With all a poet's ecstasy!
In varying cadence, soft or strong,
He swept the sounding chords along;
The present scene, the future lot—
His toils, his wants—were all forgot.
Cold diffidence, and age's frost,
In the full tide of song were lost;
Each blank, in faithless memory void,
The poet's glowing thought supplied;
And, while his harp responsive rung,
'Twas thus the latest Minstrel sung.

. . . . .

Hushed is the harp—the Minstrel gone
And did he wander forth alone?
Alone, in indigence and age,
To linger out his pilgrimage?
No. Close beneath proud Newark's tower
Arose the Minstrel's lowly bower;
A simple hut; but there was seen
The little garden hedged with green,
The cheerful hearth, and lattice clean.

. . . . .

So passed the winter's day, but still,
When summer smiled on sweet Bowhill,
And July's eve, with balmy breath,
Waved the bluebells on Newark heath;
When throstles sung on Harehead shaw,
And corn waved green on Carterhaugh,
And flourished broad, Blackandro's oak,
The aged harper's soul awoke!
Then would he sing achievements high
And circumstance of chivalry,
Till the rapt traveller would stay,
Forgetful of the closing day;
And noble youths, the strain to hear,
Forsook the hunting of the deer;
And Yarrow, as he rolled along,
Bore burden to the Minstrel's song.

TO A WATERFOWL

William Cullen Bryant, who was born at Cummington, in the State of Massachusetts, November 3, 1794, and died in New York, June 12, 1878, was one of the greatest poets America has produced. In his poetry we find a deep understanding of Nature and a steady, serene faith in the Providence which guides the wondrous life of earth. The manner of his poetry is, however, rather that of a scholar than of one who sings direct his untaught thoughts of Nature. In the following poem these qualities are all displayed.

WHITHER, midst falling dew,
While glow the heavens with the last steps of day,
Far, through their rosy depths, dost thou pursue
Thy solitary way?

Vainly the fowler's eye
Might mark thy distant flight to do thee wrong,
As, darkly painted on the crimson sky,
Thy figure floats along.

Seek'st thou the splashy brink
Of weedy lake, or marge of river wide,
Or where the rocking billows rise and sink
On the chafed ocean-side?

There is a Power whose care
Teaches thy way along that pathless coast—
The desert and illimitable air—
Lone wandering, but not lost.

All day thy wings have fanned,
At that far height, the cold, thin atmosphere.
Yet stoop not, weary, to the welcome land,
Though the dark night is near.

And soon that toil shall end;
Soon shalt thou find a summer home and rest,
And scream among thy fellows; reeds shall bend
Soon o'er thy sheltered nest.

Thou'rt gone, the abyss of heaven
Hath swallowed up thy form; yet, on my heart
Deeply hath sunk the lesson thou hast given,
And shall not soon depart.

He who, from zone to zone,
Guides through the boundless sky thy certain flight
In the long way that I must tread alone,
Will lead my steps aright.

A TERNARIE OF LITTLES

The word "ternarie" signifies a group of any three things, each of which may be different. Thus Robert Herrick, whose famous poem, "Fair Daffodils," we read on page 2125, has given the above title to these very dainty verses because in each one of them he mentions three "littles."

A LITTLE saint best fits a little shrine,
A little prop best fits a little vine;
As my small cruse best fits my little wine.

A little seed best fits a little soil,
A little trade best fits a little toil;
As my small jar best fits my little oil.

A little bin best fits a little bread,
A little garland fits a little head;
As my small stuff best fits my little shed.

A little hearth best fits my little fire,
A little chapel fits a little choir;
As my small bell best fits my little spire.

A little stream best fits a little boat,
A little lead best fits a little float;
As my small pipe best fits my little note.

BABYLAND

This charming little poem recalls the children's verses of the late Eugene Field, which we know so well, but it is not by him, having been written by an author named George Cooper.

"How many miles to Babyland?"
"Any one can tell!
Up one flight;
To the right.
Please to ring the bell."

"What can you see in Babyland?"
"Little folks in white—
Downy heads,
Cradle-beds,
Faces pure and bright."

"What do they do in Babyland?"
"Dream and wake, and play,
Laugh and crow,
Shout and grow.
Jolly times have they!"

"What do they say in Babyland?"
"Why, the oddest things!
Might as well
Try to tell
What a birdie sings!"

"Who is the Queen of Babyland?"
"Mother, kind and sweet;
And her love,
Born above,
Guides the little feet."

THE RIVER

Poets have ever loved to write of flowing streams, for there is nothing in Nature so charged with poetry and the mystery of life as the river on its way to the sea. It is the commonest illustration of this moving, changeful life of ours, and has been used in many different ways, as suits the poet's mood. We saw with what dramatic power Kingsley wrote of the river in his poem on page 2648, while Tennyson in "The Brook," on page 95, and Southey in "The Cataract of Lodore," on page 1274, deal with the poetry of rushing water with wonderful effect. But the following is just a pretty song by Mr. Frederic E. Weatherly, who turns the river and its music into a soothing melody of gentle life.

WHERE do you come from, river sweet?
Whence do your wavelets roam?
Is it a lake, or a mountain brake,
Where fairies make their home?
Is it a land where children play,
Or old folks dream at close of day?
"Nay," said the river, whispering low,
"It is from Babyland I flow!"

Why do you hurry, O river fleet?
Can you not stay your stream,
And waft me tenderly soft and sweet
Back to that land of dream?
Can we not turn and play once more
In Babyland, as we played of yore?
"Nay," said the river, "that may not be,
There's no returning for you or me!"

Whither away, I cried again,
Whither away, O stream?
Do you rest at last when your journey's past
In some beautiful land of dream?
Is it a land that we may know,
And find the peace of the long ago?
"Yes," said the river, "a land that's blest;
'Tis the land of love and eternal rest!"

LITTLE·VERSES·FOR·VERY·LITTLE·PEOPLE·

AS I WAS GOING TO St IVES,
I MET A MAN WITH SEVEN WIVES;

EVERY WIFE HAD SEVEN SACKS,

EVERY SACK HAD SEVEN CATS;

EVERY CAT HAD SEVEN KITS:

KITS, CATS, SACKS, AND WIVES,

HOW MANY WERE THERE GOING
TO St IVES ? ? ? ?

S C Burnside

For want of the nail the shoe was lost;

For want of the shoe the horse was lost;

For want of the horse the rider was lost;

For want of the rider the battle was lost;

For want of the battle the kingdom was lost;
And all for the want of a horse-shoe nail.

As I went to Bonner,
I met a pig
Without a wig,
Upon my word and honour.

There was a jolly miller
Lived on the River Dee;
He worked and sang from morn till night,
No lark so blithe as he;
And this the burden of his song
For ever used to be—
I jump mejerrime jee!
I care for nobody—no! not I,
Since nobody cares for me.

We are all in the dumps,
For diamonds are trumps,
The kittens are gone to St. Paul's,
The babies are bit,
The moon's in a fit,
And the houses are built without walls.

What is the news of the day,
Good neighbour, I pray?
They say the balloon
Is gone up to the moon!

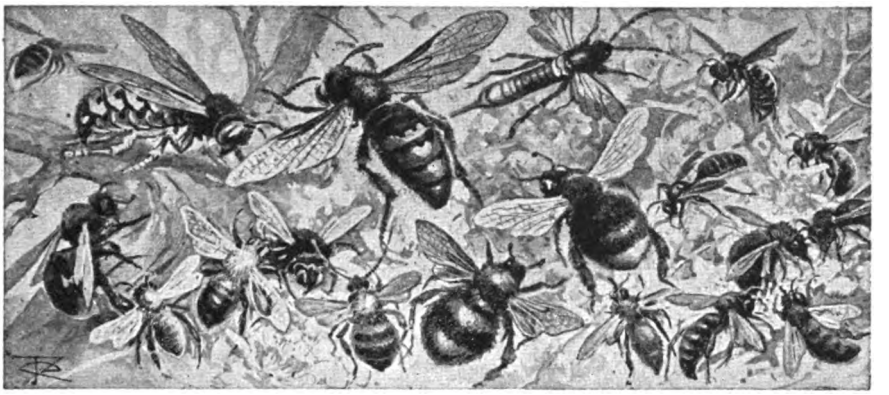
March winds and April showers
Bring forth May flowers.

High diddle ding,
Did you hear the bells ring?
The Parliament soldiers are gone to the King!
Some they did laugh, some they did cry,
To see the Parliament soldiers pass by.

Wee Willie Winkie runs through the town,
Upstairs and downstairs in his night-gown,
Rapping at the window, crying through the lock,
"Are the children in their beds, for now it's eight o'clock?"

One misty, moisty morning,
When cloudy was the weather,
There I met an old man
Clothed all in leather;
Clothed all in leather,
With cap under his chin—
How do you do, and how do you do,
And how do you do again?

Hector Protector was dressed all in green;
Hector Protector was sent to the Queen.
The Queen did not like him,
No more did the King;
So Hector Protector was sent back again.



THE BEES AND WASPS

CONTINUED FROM 2684

THE insect world is more crowded with life than any other part of the globe—the sea, of course, excepted. We cannot count the number of living things in the sea, nor the tiny living things on land, but we know that the insect *species* are more numerous than the species of all the rest of the animal world. Nobody has yet been able to classify them all; probably nobody ever will—the number is so vast. Science counts over 80,000 different species of beetles; and about 15,000 different moths and butterflies. One authority puts down the number of species of insects at 200,000; but another student, going more thoroughly into the question, believes that in the future our scientists will classify a million species.

Many insects are harmful to us, but many are very valuable. In spite of all that we may do with deadly powders and deadly liquids for washing and spraying trees and plants and crops, we should be overrun with harmful insects were it not for the work of other insects. Insects prey upon insects. There are 10,000 species of ichneumon flies alone which prey upon other deadly enemies of the gardener. All that they do is to follow their natural instinct; they assist us without knowing anything of their value. Other insects help to make outdoor life more beautiful by the splendour of their appearance. The bodies of some yield valuable medicine and dyes; others form the food of birds. But there is a more important work than this that the insects do for us. Some carry the pollen from flower to flower, so making plants and trees fertile and able to yield their harvest of flowers and fruit. Without the insects many of our flowers would die out, and many trees would fail to yield perfect fruit. Some, again, act as scavengers, and perform highly important work in consuming offensive material which might be dangerous to health.

At the head of the insect family come the bees, wasps, and ants. Their skill is so remarkable, their organisation so extraordinary, that there is a danger of our giving them credit for too much wonderful knowledge, and of our ascribing to very high intelligence works and ways which proceed from that governing influence in animal life which we call instinct. But we can leave out of account the difficult problem as to where instinct ends and intelligence begins. We believe that bees must think and reason; we know that a sudden, unexpected event will cause them to ponder and make fresh plans, just as human beings would.

The story of the bees is just like a fairy tale. They are creatures of the sunlight; their food is the sweet nectar and nourishing pollen of the

flowers, just the sort of diet that our fairies ought to have. They have their queen and their princesses; they have their willing slaves; they have their lazy idlers. They live in an enchanted castle to which dreadful enemies sometimes come. Against them the bees have to resort to the most wonderful defences. They have their love stories; they have their quarrels. Worst of all, they have their dreadful tragedies. They commit murder upon a great scale every year. It is not murder to them; it is only the carrying out of a necessary law of the city in which they live. They are wonderful architects and builders; they have the gift for finding their way about in the open air back to their homes, which birds possess. They have splendid sight, keen sense of taste and smell, and they love each other's company so much that if deprived of the companionship of other bees, they die.

Whence came the wonderful organisation of the hive-bees? It is believed that the hive-bees are the highest order in a great family which has for long, long ages been constantly improving.

How the bees changed their shape to gather food from the flowers

The first bees, it is supposed, were a not very advanced type of wasps which ate flesh. From these descended bees which gradually took to food from the flowers. To do this they had to alter their shape. They had to develop the honey-sucking instrument with which they are now provided; and they had also to grow the honey-sac which lies in the lower half of the bee's body. Each of these would build its nest by itself, but near the nests of its fellows, like a family of land crabs of which we have been reading.. Little by little they would make their homes and honey-stores nearer together, until at last they would join homes and share their food and the labour of the dwelling.

In this dwelling, be it hive made by man, or the hollow trunk of a tree, or any other natural retreat, there is one bee which is queen and mother. Nearly all the rest are her children and willing slaves. We have read of the enormous number of eggs which fishes lay, so need not be surprised to learn that the queen bee may lay as many as 3,000 eggs a day until the 60,000 or 80,000 cells of the comb have all received an egg, and, in some cases, a second egg to replace that from which a young bee has been hatched. But how came these bees into a hive? How came they to have a comb ready for the reception of their queen's eggs?

How the bees leave their home and build a new city without tools

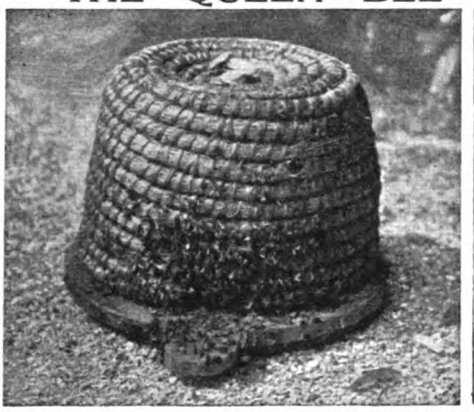
We must begin our story at the point where the queen leaves the home in which she was born, followed by a great company of worker bees, and establishes a colony of her own. Let us suppose that, having flown from home, they decide to take possession of one of those old straw hives in a country garden. In a hive scientifically planned they would find frames inside ready for them, with foundations of wax prepared, upon which they would at once set to work to build up the cells for the reception of the eggs or for the storage of honey.

But here, in an old-fashioned hive, they have nothing but a great dark space overhead and rough walls all round them. It is as if we ourselves were given some mighty cavern in which to build a city. But, lacking tools and materials of every sort, how should we build? The bees are in just that position; they have no materials with which to build, no artificial tools with which to work. Nature has given the bees their materials and tools in their own bodies. As soon as they enter the hive, a great number of the bees climb up the walls of the hive and suspend themselves from the roof. Those highest hang by their front legs; those lower down cling to the hind legs of those above; others at the sides cling as well, so that we have a great curtain of bees hanging down from the roof for three parts of the depth of the hive.

The mystery of the change of honey into wax, which no man understands

There they hang for nearly a day and a night. They are letting the honey which they have eaten change into wax. Before leaving the old home, each bee had gorged itself with honey to serve as food and to change into this important wax. How they make the change we do not know. We only know that they hang there for nearly twenty-four hours, and that at the end of that time the honey has been changed into wax, and is seen to issue

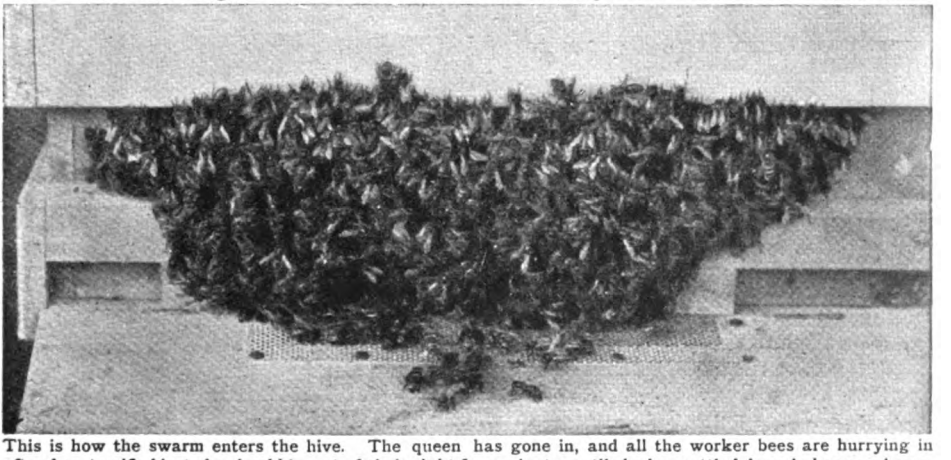
THE QUEEN BEE AND HER COURT



This is an old-fashioned hive called a skep. The bees which are clustering about it seem ready to fly off with their queen, and set up a home of their own with her.

This strange-looking object is a swarm of live bees. The queen has settled on one of the branches of an apple-tree, and the other bees are all clustered about her.

Here we see the queen and her court. In the middle of the picture is the queen bee. The bees near her are her maids of honour, all with their heads turned towards her, paying her the same respect that men and women show their sovereign at court. When these courtiers retire, they move backwards, still facing the queen.



This is how the swarm enters the hive. The queen has gone in, and all the worker bees are hurrying in after her, terrified lest she should be out of their sight for a minute, until she has settled down in her new home.

like flakes from between the horny rings of which the lower parts of their bodies are composed. While this silent work progresses up above, the remainder of the bees below are running over the walls, making all smooth and neat; carrying out every speck of dirt and dust and rubbish.

When at last the wax is forthcoming, a bee from the middle of the cluster climbs up over the others and clears a little space of bees in the centre of the roof. Then it carefully collects the wax which has gathered about its body. This it kneads and moistens with its tongue and pincers until it becomes like glue. Then the bee deposits the little mass of soft wax upon the roof and sticks it there. This is the laying of the home's foundation-stone, only instead of being like ours, under the house, it is at the top. This bee then returns to its place, and more bees, one after another, follow and do the same with their store of wax, until a little heap of it is collected upon the roof.

THE BEE ARCHITECT BEGINS TO DESIGN THE HONEYCOMB

Then there comes forth an architect bee, which examines the wax, pats it here and there with its antennæ, or feelers, and, finding all satisfactory, bores in the middle a hole, which is the beginning of the first cell.

The material dug out is carefully pushed to one side to extend the walls of the cell. Other bees follow to deposit wax, and these give place to more architects, which excavate other cells, and the task of building the comb is now really well on its way. Each cell is perfectly formed. It is a six-sided cylinder, made with such marvellous accuracy that the hands of man find it impossible to equal it. Those wax foundations which we put in to give the bees a start are never quite satisfactory. The impressions of the cells marked upon the wax do form the bases for the bees to work upon, but the little creatures go to work upon them with their own wax and implements to perfect them. The wax as it grows down from the roof of the hive is thick like a wall, or rather several walls. The bees build the walls half an inch apart, so that there is room for them to pass in between and work. One set of bees works on one side of the wax and another set of bees works on the opposite side of the wax. And such extraordinary skill do they show that they make a cell on each side meeting precisely in the centre of the wax, so that the end of the cell on the right side of the wax is the end also of the cell on the left side of the wax. Thus, there is not a fragment of waste; there is not an atom of weight more than the structure can bear.

THE QUEEN BEE AND HER COURTEOUS MAIDS OF HONOUR

The work goes forward with great speed, so that in the course of twenty-four hours they have built a comb more than two feet in length, and seven or eight inches in width. And now the important work in the life of the hive begins.

All this time the queen bee has been very restless and discontented. As soon as some cells are ready, the queen, attended by her maids of honour, goes from one cell to another, and in each deposits an egg. Her attendants respectfully keep her company. They form a circle about her, all with their heads towards her. Bees which are her own attendants never turn their back upon their queen. They walk backwards before her; they bow before her; they hum and buzz their song of love and joy; they caress her with their antennæ; they feed her, as often as she can take food, with the choicest honey and masticated pollen, which we call bee-bread. The whole company of bees worship her with a reverence and affection hardly to be matched throughout the rest of the animal kingdom. The eggs are rapidly laid, more rapidly at the outset than the little builders making the cells can keep pace with. When they do gain on her they make cells in which they can store the honey and pollen that the hunters bring in.

THE QUEEN BEE LAYS EIGHTY THOUSAND EGGS IN EIGHTY THOUSAND CELLS

At last the whole comb is finished, and the queen is free to lay the eggs for workers, drones, and princesses. By the time that she has deposited an egg in each of the 60,000 or 80,000 cells, the eggs first deposited have hatched; the cells have been repaired and are ready to receive additional eggs. Till the end of September the queen will go on laying her eggs in the comb.

Now we must turn to the history of

HOW WE GET THE HONEY FROM THE HIVE

The first picture shows how bees are driven from the combs in the old straw hives by the modern bee-keepers instead of suffocating them with sulphur fumes, which used to be done to obtain the honey they had stored. In the second picture he is handling them to show how harmless they are at these times.

The bee-keeper wants to see how the bees are faring. He removes the top of the hive and puffs in some smoke. This makes the bees fear disaster, so they gorge themselves with honey, expecting to have to fly away. As we see in the second picture, the keeper can now safely lift up a frame with the bees working on it.

When we keep bees we do not leave them to begin the work of making the comb. We start each section with a thin sheet of wax. This makes the work of the bees lighter, and gives them more time to collect honey. Each time we take out a section full of honey, we put in others, like those in the left-hand picture, containing new wax.

the egg. This is a little bluish-white thing which is fastened to the bottom of the cell, and thus remains for three or four days. At the end of that time a little larva or grub appears. In its cell it finds an ample supply of food which the nursing bees have placed in readiness for it. It floats in food, and, absorbing this supply, rapidly grows until its head reaches the top of the cell. There the nurses fondly feed it for the next five or six days. Under this treatment the grub waxes fat and strong. But after a certain point grubs are not fed on a rich diet, if they are to be worker bees. At first they are fed on a sort of milk supplied from a gland in the head of the nursing bee, a very rich and strengthening diet. But this ceases when the future worker has been a few days in the grub form. After that it receives only a coarser food, consisting of honey and pollen, which have not previously been digested by the nursing bees. After its course of this food, the worker grub ceases for a time to feed. It is built into its cell by the nurses, which cover over the top of the cell with wax.

THE GRUB THAT BECOMES A BEE, AND GNAWS ITS WAY OUT OF ITS CRADLE

During the next thirty-six hours the little grub spins itself into a robe of silk, a cocoon inside the cell, and there it rests, to let Nature work its mysterious way. In three days its form undergoes a striking change. It is no longer a grub; its internal organs have been remade; wings and legs have grown, and in the next six days these reach perfection of form, and the young bee is ready to come forth into the hive. With its strong mouth it gnaws away the covering of its cradle. The nursing bees flock to help it out, and there emerges a worker bee ready for any task which it may be called upon to discharge.

It may be sent out at once to gather honey and pollen, but most likely it will stay a week in the hive helping the nurses, or joining the scavengers or the engineers, who look after the ventilation. This latter is very important work. In the summer days the hive becomes very hot, so hot that the wax walls of the city become soft and bent. To guard against this, the workers take up their stations and vigorously fan with their wings. So strong a current do they create that a match placed inside the hive is blown out; while, if we put our hand before the entrance to the hive, we can distinctly feel the air being drawn into the hive from the outer atmosphere. The fanners take turns at this work.

THE FIERCE FIGHTING OF THE QUEEN BEES TO SAVE THEIR FAMILIES

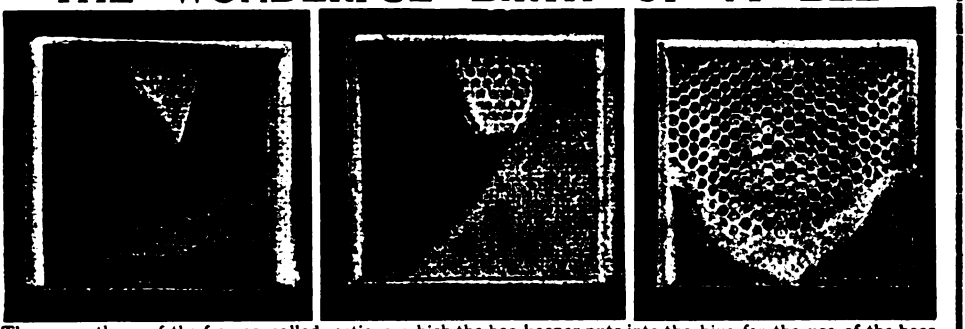
Meanwhile, what about the royal princesses? These may one day be queens—not all queens of this hive, but of other bee colonies. The bees serve only one queen at a time. Queen bees kill each other with relentless fury. This must at first sight strike us as unaccountable. Though a hive contains only from three to eight or nine royal princesses, the mother of them all, the queen bee, must needs turn and slay the little princesses. Nature is so wise that we must always carefully seek her reasons before saying that this or that should not be. There is a powerful reason for preventing all the young princesses from becoming queens. Were all to come to maturity and to lay eggs, the hives could not hold their families. The countryside could not supply them with food; starvation and ruin would overtake the whole family. There is a special provision which enables the queen bee to kill the princesses as they lie in their cells; but they are not always killed, as we shall see. But we left the princesses as little eggs.

Although specially large cells are made for the princesses, as for the drones, the worker bees have the power, up to the time that the grub is three days old, to change an ordinary worker grub into a princess. The feeding is the one thing which makes the difference.

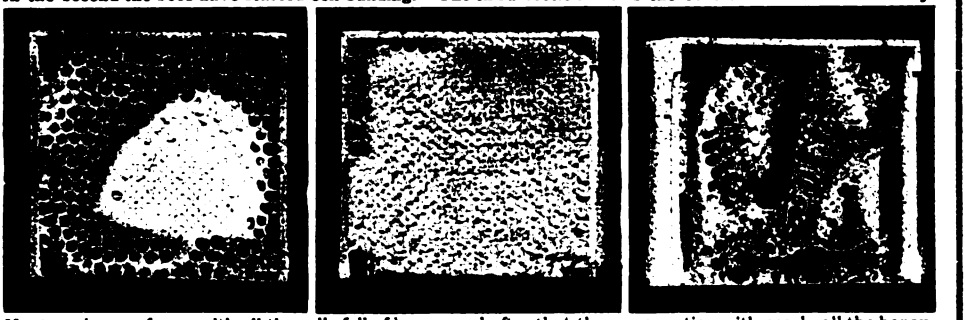
THE CHANGE OF FOOD THAT TURNS A WORKER INTO A ROYAL BEE

Suppose that some great disaster should overtake the hive, that the queen, after killing the princesses, should die, there would be neither queen nor royal daughters left; all hope for the future would be gone. It would mean that the bees would simply abandon work and die. But if they have grubs which have been not more than three days out of the egg stage, they take one or more of these and feed them with the royal jelly, not on the undigested pollen and honey. This diet must be given before the grub

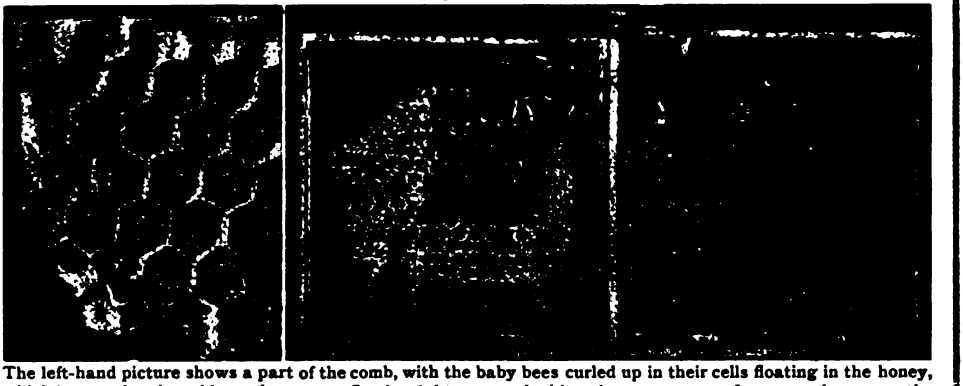
THE WONDERFUL BIRTH OF A BEE



These are three of the frames, called sections, which the bee-keeper puts into the hive for the use of the bees in making the comb. In the first we see the section with the wax foundation made ready for the bees. In the second the bees have started cell-building. The third section shows the centre cells filled with honey.



Next we have a frame with all the cells full of honey, and after that the same section with nearly all the honey-cells sealed over with wax. The third is bad work by bees who built their cells without proper foundation wax.



The left-hand picture shows a part of the comb, with the baby bees curled up in their cells floating in the honey, which is to make them big and strong. On the right we are looking down upon two frames and can see the bees actually at work. They are sealing the honey-cells with wax and making all neat in their storehouse.

In these three pictures we watch the birth of a worker bee. In the middle of the first picture there is a half-circle mark, showing where the cell is being opened. Next we see the young bee with its head and half its body free from the cell. In the third picture we see it quite out of the cell, and ready soon to start work.

is more than three days old, or the case is hopeless. Upon this diet the little worker grub becomes suddenly fat and big and strong and royal, and an important change comes over her constitution. She will become a queen like any bee destined, from the moment that the egg was laid, to be a queen. Up to the last minute the grub, which is now to be a princess, is fed on this rich fare, and when the time comes for her to be sealed up in her cell she is big and strong.

THE PRINCESS WHO SPINS A SILKEN ROBE, AND THE SAD FATE THAT MAY AWAIT HER

She spins herself a silken robe, but this does not cover her as do the robes of the worker and drone. The princess's cocoon reaches from the head down over only half of her body. The only part in which she can be stung to death is between the rings of which the abdomen is formed. These rings are deliberately left uncovered, so that should the old queen be in the hive, and suddenly make up her mind to commit murder, the little princess lies ready to be immediately sacrificed, unprotected by the silk which would hamper the old queen in planting her fatal sting.

But the better to trace the life of the princesses, let us fancy ourselves in the hive from which our first queen and her swarm of bees proceeded. She and they came out because their work in that hive was done. She has filled that comb with eggs. There will be in the comb some 10,000 eggs, some 18,000 grubs—or larvæ—and seven or eight princesses. There is nothing more for the queen and her workers to do. They have filled the hive with new life, and with honey and pollen for further use. There is no more room; they *must* go forth, for the year is young and the queen has thousands more eggs to lay. That is why they swarm; that is why the queen and the bees which in fancy we have been watching came to our present hive.

THE TREMBLING OF THE WORKER BEES WHEN THE QUEEN BEE GROWS FURIOUS

A few days before she left, the princesses were getting ready to leave their cells. They raised their voices, and piped, and she, hearing their cries, was roused to fury, and went to the cells to kill them all. Now, had it been towards the end of the summer, when the time for swarming had passed, the workers would not have hindered her; they would probably have encouraged, even helped, her to kill all the princesses. But this is the early part of the summer, and the wise bees know that before the summer ends they may have to send forth other swarms led by queens. So when the furious old queen draws near, intending to slay the little princesses, they form a guard round each cell, and firmly—even roughly, if compelled—keep her from doing as she wishes. She raises her voice in a shrill, indignant piping. This subdues her followers, and they draw aside to let her pass, for they cannot disobey her voice. But as she moves forward again her voice ceases, and they regain their senses and again block the path. In the meantime the princess who is most advanced hears the cries of the queen, and answers her challenges and endeavours to bite her way out. But the wise nurses know better than to let her have her way. They heap wax on the top of the cell and keep her in.

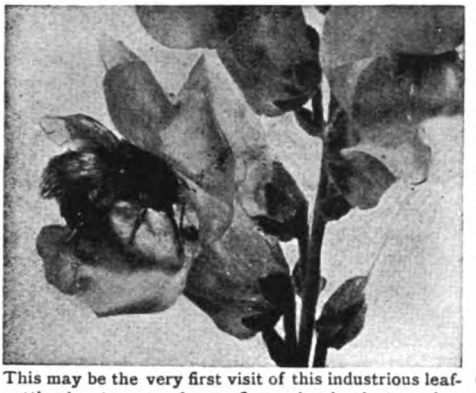
When at last the old queen goes forth, two-thirds of the bees follow her out to the new home; one-third remain to carry on the work of the hive, to see to the nursing and ventilating, to the guarding of the doorway, and to the bringing in of food.

THE BIRTH OF A PRINCESS, AND HOW HER STAFF OF NURSES CARES FOR HER

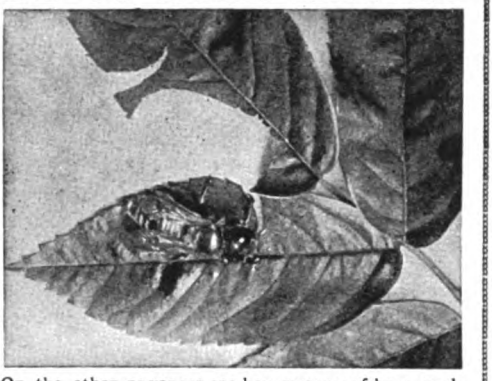
Now the most advanced princess is at liberty to come from her cell. Anxiously the nurses help her. As she emerges, they caress her, offer her honey with their mouths, brush and clean her to remove any shreds or stickiness which may have adhered to her in the cell. It is always arranged that princesses shall not be born on the same day. Were it otherwise, and two princesses appeared at the same moment, they would fight to the death. One princess comes forth, therefore, at a time.

As soon as the little stranger feels strength come into her legs and jaws—which is about ten minutes after she leaves the cell—she is seized with the same fury that the old queen showed. She rushes to the cells of her sister princesses, and, if the workers let her, tears open the cells and destroys the occupants. But they do not let her if they think that more swarms will go forth from the hive, for then it would be left without queen or princess.

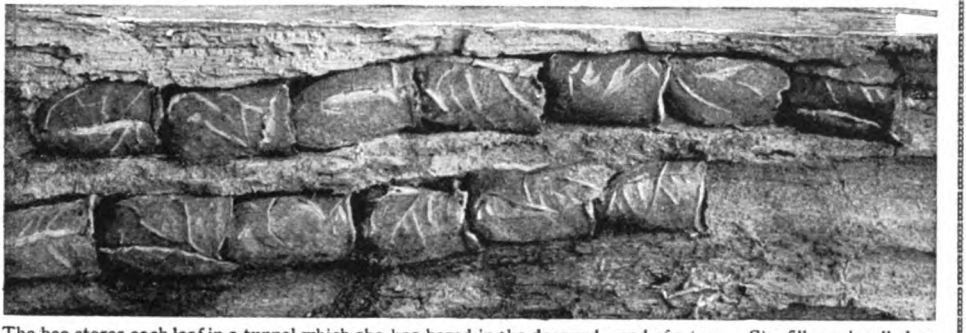
A BEE'S CRADLE MADE OF ROSE LEAVES



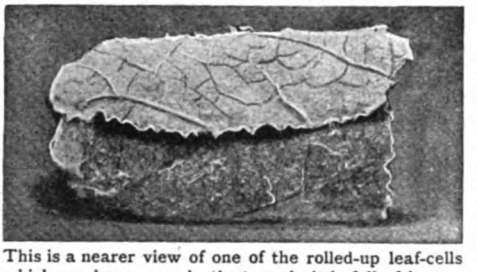
This may be the very first visit of this industrious leaf-cutting bee to a snapdragon flower, but instinct teaches her just how to force her way in to extract the honey.



On the other pages we see how swarms of bees work together, but this leaf-cutting bee works alone, and very clever she is. Here she is cutting rose leaves for her nest.

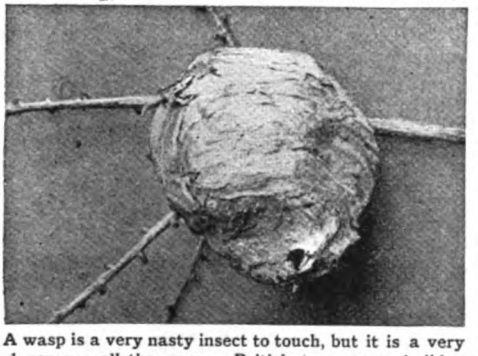


The bee stores each leaf in a tunnel which she has bored in the decayed wood of a tree. She fills each rolled-up leaf with honey and then lays an egg in each. This is a picture of wood cut open to show two such tunnels

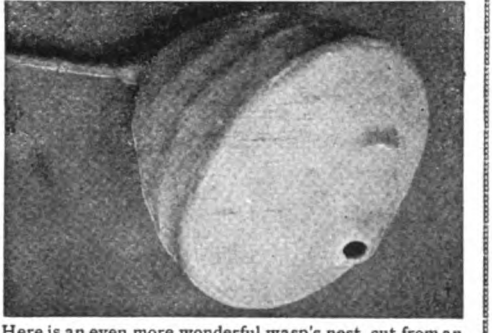


This is a nearer view of one of the rolled-up leaf-cells which we have seen in the tunnel; it is full of honey.

Here we see the leaf-cell cut open. Inside is the little bee grub eating the honey that its mother had stored.



A wasp is a very nasty insect to touch, but it is a very clever one all the same. British tree-wasps build a nest like this. The nest in early summer is like a small plum, but soon it grows to be the size of a football.



Here is an even more wonderful wasp's nest, cut from an orange-tree in Brazil. Made of a substance like stout cardboard, it is really wood pulp, collected and worked up by the wasps. The little black hole is the entrance.

If by any chance two princesses should be matured and come forth on the same day, then they have to fight a great battle. Parties of workers surround each young queen, and do not let her move until she shows a desire to fight the other queen. Then the workers draw aside, and the two queens engage and fight until one stings the other to death.

THE PRINCESS WHO CONQUERS HER RIVAL AND IS GREETED AS QUEEN OF THE BEES

It sometimes happens that the two bees in their struggles find themselves so placed that each could kill the other at the same moment. If they both struck now, they would die and leave the hive without a queen. They do not strike; they break away, terrified at the danger that both may be killed, and they fight again until one, more skilful or stronger than the other, can implant its sting, inflicting the fatal blow. The victor is always dutifully received as the sovereign.

During the next few days many more worker bees are hatched from the eggs which the other queen had laid, and the new queen, after one trip to the skies, will begin to lay her eggs. She in turn will now want to lead away a swarm of bees to set up a colony for themselves, and the bees are just as anxious to go. In a wild state the bees will send off several swarms in succession, from five to ten days elapsing between the departure of each swarm. But in hives owned by men this number of swarms is not permitted, or the hive would become too weak. The queen and her court feel the desire to go, and forth they fare, flying at first only a short distance from the hive. There, upon some bough, they hang in a bunch, the bees frantically clustering about their queen to prevent her being injured.

BEES THAT FILL THEMSELVES WITH HONEY AND ARE TOO LAZY TO STING

The prudent bee-keeper now comes along, holds a hive upside down under the bees, and by shaking the bough up and down causes them to drop into it. He knows that they will not sting him; they have filled themselves so full of honey before quitting the hive that they have no desire to injure anybody. That, by the way, is the reason why, when we want to withdraw part of the comb containing the honey, we "smoke" the bees. We use a small pair of bellows inside which a piece of rag is smouldering. The bees do not understand the smoke; they think that something dreadful has happened to the hive, and that they may be compelled forthwith to quit. So they rush to their stores of honey and fill themselves with the sweet food, in case they have to set forth on a journey. When they are in that condition they never sting unless they are ill-used.

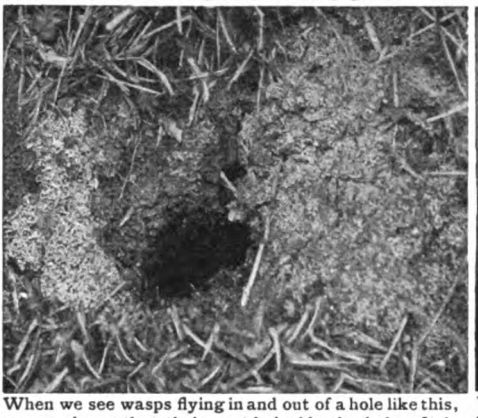
The affection and reverence which the bees show for their queen cannot be exaggerated. If famine overtakes the hive, they feed the queen with the best food remaining; and if the queen be sent away packed up in a tiny, tiny hive, with her personal attendants accompanying her, they feed her so long as a scrap of food remains, and die themselves rather than take anything that she might eat. But we must leave all the fascinating relations of the members of the family to more deliberate study.

IF ANY BEE WILL NOT WORK NEITHER SHALL HE EAT

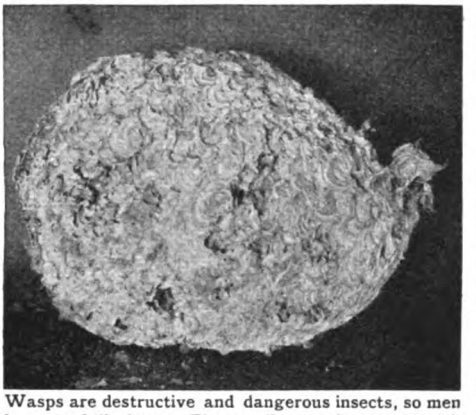
When we come to read all about bees in big books, or examine the hives for ourselves, we shall have to follow the lives of the drones more closely than we have done here. Their lives are short and idle. They only exist that the queen bee may choose a mate from one—not of her own hive, but from the drones of another hive; while her hive supplies drones as mates for other queens. The worker bees have to feed the drones, but when the summer is ending they turn them all out of the hive to die, or else imprison them inside and starve them to death or actually kill them.

One little point we must note before leaving the hive. For all their skill, the bees are sometimes deceived. The death's-head moth enters the hive, being able to do so, it is believed, because it utters a cry like that of the queen bee. Nothing else can get in, in the ordinary course, for there are sentinels at the door, who examine every creature, friend or foe, that seeks to enter. A strange bee is at once killed or expelled, unless it brings honey, when it will be welcomed. Sometimes a big snail will enter, regardless of stings. The bees cannot have him there alive, so they wall him up. They seal up his shell with their wax,

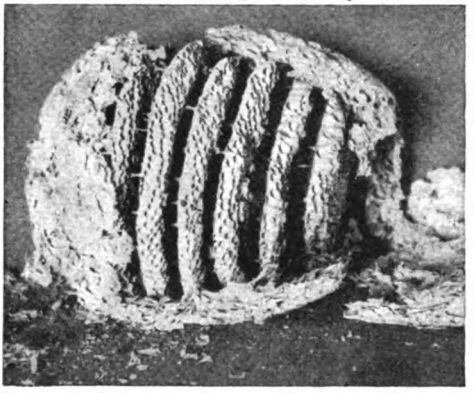
THE STRANGE HOMES OF WASPS

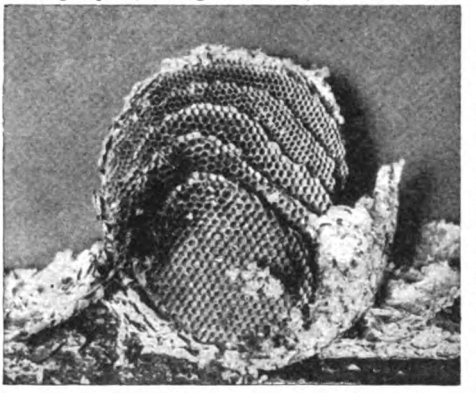


When we see wasps flying in and out of a hole like this, we may know that their nest is inside the hole. It is built some feet under the ground, away from harm.

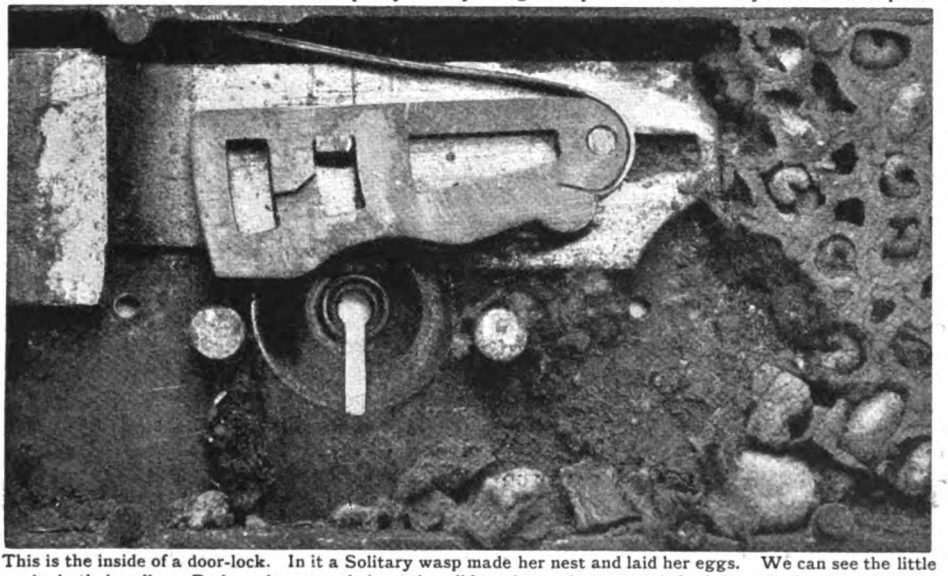


Wasps are destructive and dangerous insects, so men have to kill them. They suffocate the wasps with burning sulphur, and dig out the nest, which is like this.





Stripped of the paper-like covering which the wasps have made, the nest is seen to consist of a series of cell-combs. Here we get, first a side view, and next a front view of the nest dug out of the hole in the ground shown above. This wonderful home was partly built by a single wasp before she had any children to help her.



This is the inside of a door-lock. In it a Solitary wasp made her nest and laid her eggs. We can see the little grubs in their cells. Perhaps because their mother did not leave them enough food they all died of starvation.

The photographs on these pages are by Oliver Pike, Charles Reid, Frances Pitt, W. B. Richardson, and others.

burying him alive, if they do not first sting him to death. If the shell be broken, they cover him entirely, so that no bad fumes shall escape from his body. As a precaution against the death's-head moth entering, the bees build walls against the entrance to their city, so that a tiny thing like the bee can enter, but a big moth cannot.

THE BEE'S LONG TONGUE THAT SUCKS UP THE NECTAR FROM THE FLOWERS

The doings out in the field and gardens of the worker bees are as interesting as those in the hive. They have a curious sucking tongue, covered with hairs. This they protrude from a strong sheath, which acts as a channel, up which they draw the nectar from the flowers. When they enter a flower in which the nectar lies ready, they stretch out their tongues and suck up all that is available. If the nectar lies hidden, they bite their way through that part of the flower which obstructs them, and so reach it. The pollen that they collect, as they go from flower to flower, is highly important to them and to the flowers. It gets dusted over their bodies, and, as they go from bloom to bloom, the pollen of one flower is transferred to another, so carrying fertilisation to each. They generally take the same sort of flower on one round, so that they should not mix the pollen of various plants.

The pollen that clings to them they scrape off with their claws, and deposit in two tiny baskets which they have on the joints of their hind legs. A little of the pollen they eat as food, but the bulk of it they carry back to the hive, where the workers take it from them and use it at once as food for the grubs, or store it in cells set apart for the purpose. The nectar which the bees sip is swallowed. Some of it is used to give the bee strength, but the greater part passes immediately from the bee's stomach into the pouch beyond, where it becomes changed into honey. This honey is delivered to the hive and stored in cells. When these are to be kept for future use, the bees place in each cell a tiny drop of acid from their stings. This preserves the honey from going bad.

THE GREAT PRICE THAT JAPAN PAYS FOR THE LAZINESS OF THE BEES

Many queen bees have been carried from America to Japan, solely that they may raise bees like themselves, which will visit the fruit-trees and give Japan good, sweet, home-grown pears and apples, neither of which she has hitherto possessed. The absence of good fruit of this sort in Japan has been due to the fact that the native bees of Japan are too lazy to work as ours work. They eat just as much nectar as they need for immediate use, and do not store for the future; hence they have no need to go from flower to flower as good bees will.

There are scores of species of bees, but we must leave them to glance for a moment at the wasps. We can all tell at a glance the difference between these and bees. The wasp is of a lighter colour, is more slender in build, and is not so hairy. There is this difference, too, that all the wasps, save their queens, die at the end of the summer. This is not so with the bees. The worker bees born in the early summer toil so hard that they live only about six weeks, but those born at the end of the summer live snug and quiet in the hive throughout the winter. The wasps have no storehouses, and make no honey. They eat the juice of ripe fruit, they eat insects, and the flesh of dead animals; there is little that they will not eat, and they do great damage to fruit.

THE QUEEN WASP THAT WAKES UP TO FIND ALL HER RELATIONS DEAD

The common yellow wasp makes a very nice nest in the ground or hollow trees or under the eaves of houses. The queen wasp goes to sleep for the winter and wakes up in the spring, to find herself without a single relation in the world. She makes a cell or two, and lays eggs in them. These produce worker wasps, who help her to build other cells, and soon a big nest is formed. Sometimes the nests reach an enormous size, but it is only for a summer, all save the queen wasp dying in the autumn. Of course, in a year of many wasps there remain many queen wasps, all of whom will produce numerous families in the following year.

Our blue wasps mostly, but not all, make their nests of a substance like light brown paper. It consists of woody fibrous matter which the wasps have chewed. It was the nest of wasps which first gave man the idea of making paper from wood which had been reduced to pulp. There are many species of wasps, and some of them are wonderful nest-builders.

The next story of Nature is on 2941.

THE STORIES OF CHARLES DICKENS

THE last of the famous novels of Charles Dickens which we are to read here is known to have been his own favourite, for he tells us so in the preface to it. It is also, in some details, true to his own life. As we have read his life in the "Child's Book of Men and Women," page 2312, we can see where the story resembles the biography. "David Copperfield" is written in the first person, but there are so many things to tell in it, and so little space to say them in here, that we have told the story in the third person. Although the book is a very long one, this short summary conveys its leading features. Our illustrations are from copies of the original pictures drawn for the story more than fifty years ago.

DAVID COPPERFIELD

CONTINUED FROM 2764

THE hero of this story was born after his father's death in a quaint old house, called the Rookery, at the village of Blunderstone, in Suffolk. There were very few relatives of his father or mother alive. Indeed, Mrs. Copperfield, now that her husband had died, and she had become the mother of David, seemed to have nothing in the world to live for but the care of her infant child. She was the delicate, clinging type of woman, not at all one of those bright, courageous women who, having felt the sorrow of a great loss, can still have heart of grace to struggle bravely against misfortune.

Nor did she receive any help in her time of trouble except from her rosy-cheeked, warm-hearted servant-maid, Clara Peggotty, who loved the gentle woman and her child. David's aunt, Miss Betsy Trotwood, the sister of his late father, might have made matters much better for his mother; but she was a strange woman, and, calling at the Rookery the very night that David was born, she was so disappointed to find that the child was a boy and not a girl—she had hoped it would be called Betsy Trotwood, after her—that she went away, and never saw David's mother again. A strange, hard-hearted woman, you may think; but later on we shall see if that is true.

David's early days were pleasant enough; what with the fond Peggotty and his gentle mother always thinking of his happiness, perhaps he was rather a spoiled child. But suddenly all was changed. A very haughty, overbearing man, named Edward Murdstone, had got to know the young widow of the Rookery, and determined to make her his wife and himself master of what little property she possessed. He was a wine merchant, but not a wealthy man, and a colder-hearted stepfather could never have been imposed on little David, who was now a bright, observant boy of some four or five years. David hated the tall man with the black whiskers, and he was right in doing so; for when Murdstone did become his stepfather he crushed all the joy out of the little boy's life.

Before long David's mother also began to lose heart entirely, as she was overruled in everything by Murdstone and his domineering sister, who took up her abode in the Rookery, and quickly took all the affairs of the house and home into her own hands. But for Peggotty's loyalty to David and his mother, the lives of both of them would have lost all sunshine. As it was, a day came when little David could not stand his stepfather's ill-treatment of him any longer, and he bit the hand of Mr. Murdstone when that person was engaged in punishing him for some imaginary offence.

The result of this conduct was that David, now about nine years of age, was packed off by the stage-coach, with a little box of clothing, all the way to London, where, at Salem House School, Blackheath, Mr. Murdstone had arranged for the boy to become a boarder, under the notorious Mr. Creakle, a master whose one idea of education was to thrash the boys daily. We remember Mr. Squeers, who kept

Dotheboys Hall, as a terrible schoolmaster of that time, but he was little worse than Creakle. One of the tutors, poor-spirited but kindly Mr. Mell, met David at Whitechapel, and took him to Salem House, and we shall hear how he was received there in his own words.

LITTLE DAVID'S FIRST UNHAPPY DAY AT SALEM HOUSE SCHOOL

"Salem House was a square brick building with wings, of a bare and unfurnished appearance. All about it was so very quiet, that I said to Mr. Mell I supposed the boys were out; but he seemed surprised at my not knowing that it was holiday-time. That all the boys were at their several homes. That Mr. Creakle, the proprietor, was down by the seaside with Mrs. and Miss Creakle. And that I was sent in holiday-time as a punishment for my misdoing. All of which he explained to me as we went along.

"I gazed upon the schoolroom into which he took me, as the most forlorn and desolate place I had ever seen. I see it now. A long room, with three long rows of desks, and six of forms, and bristling all round with pegs for hats and slates. Scraps of old copybooks and exercises litter the dirty floor. Some silkworms' houses, made of the same materials, are scattered over the desks. Two miserable little white mice, left behind by their owner, are running up and down in a fusty castle made of pasteboard and wire, looking in all the corners with their red eyes for anything to eat. A bird, in a cage very little bigger than himself, makes a mournful rattle now and then in hopping on his perch, two inches high, or dropping from it, but neither sings nor chirps.

DAVID FINDS THE STRANGE PLACARD: "TAKE CARE OF HIM—HE BITES"

"There is a strange, unwholesome smell upon the room, like mildewed corduroys, sweet apples wanting air, and rotten books. There could not well be more ink splashed about it, if it had been roofless from its first construction, and the skies had rained, snowed, hailed, and blown ink through the varying seasons of the year.

"Mr. Mell having left me, I went softly to the upper end of the room, observing all this as I crept along. Suddenly I came upon a pasteboard placard, beautifully written, which was lying on the desk, and bore these words: *Take care of him. He bites.*

"I got upon the desk immediately, apprehensive of at least a great dog underneath. But, though I looked all round with anxious eyes, I could see nothing of him. I was still engaged in peering about, when Mr. Mell came back, and asked me what I did up there?

"'I beg your pardon, sir,' says I; 'if you please, I'm looking for the dog.'

"'Dog?' says he. 'What dog?'

"'Isn't it a dog, sir?'

"'Isn't what a dog?'

"'That's to be taken care of, sir; that bites?'

"'No, Copperfield,' says he gravely, 'that's not a dog. That's a boy. My instructions are, Copperfield, to put this placard on your back. I am sorry to make such a beginning with you, but I must do it.'

"With that he took me down, and tied the placard, which was neatly constructed for the purpose, on my shoulders like a knapsack; and wherever I went afterwards I had the consolation of carrying it. What I suffered from that placard nobody can imagine."

THE BOYS TEASE DAVID ABOUT HIS PLACARD, BUT HE FINDS A CHUM

Here was, indeed, a terrible beginning to David's schooldays—for he was a sensitive boy, and no punishment could have equalled in its brutal effect this arranged by Mr. Murdstone. The lad spent many miserable days in terror of what would happen when the school term began again and the other scholars came to find him a subject of mockery and mirth. But when they did come, their taunts of "Lie down, sir!" and "Towzer!" were hardly worse than the fears of his loneliness. Besides, handsome James Steerforth, the head-boy of the school, speedily made a friend of David, and very readily spent for him the seven shillings which David had got from his mother and Peggotty.

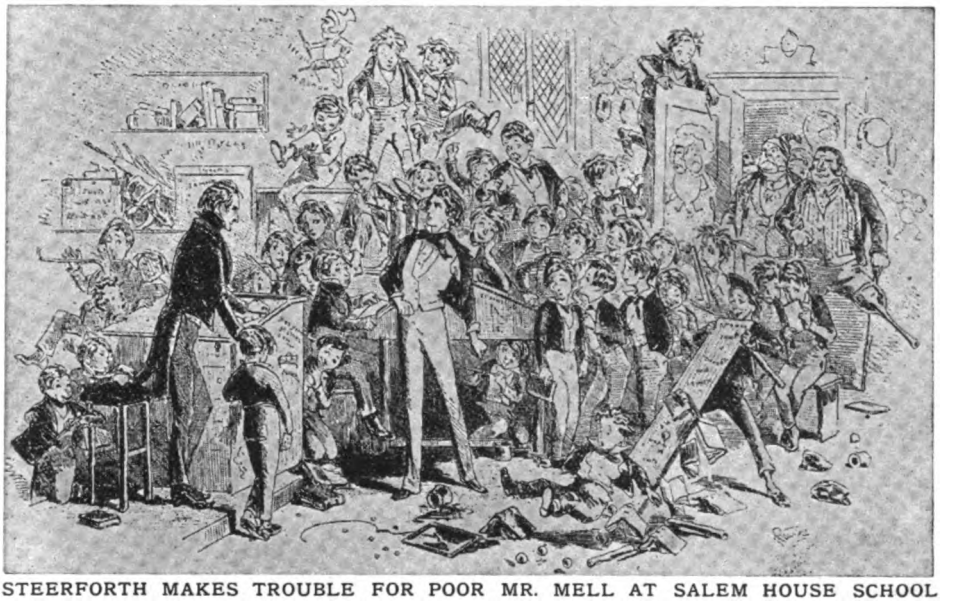
Steerforth certainly made the little fellow's life pleasanter than it could otherwise have been, and David Copperfield conceived a great admiration for him, which Steerforth seemed to return in some degree of affection for his little friend. They read stories together, and really made the best of a very uncomfortable and ill-kept school. But Steerforth, who was much older than the

other boys, and had great influence with the despicable Creakle, abused his power by picking a quarrel with poor Mr. Mell, the result of which was the discharge of that ill-used tutor. Even this indication that he could be cruel as well as kind did not shake David's faith in Steerforth, and he remained his object of admiration, while with Traddles, another schoolmate, who seemed to be the most unfortunate of little fellows, he was also very friendly.

At the end of six months David was allowed to go home for the holidays, and, to his surprise, he found his mother nursing a baby sister, who had arrived while he was at Salem House. His mother made every effort to appear happy, but even the boy could see she was not happy, and the fact that Mr. Murdstone ordered him about like a dog, and would not let him be friendly with Peggotty, his old nurse, made home almost less endurable than Salem House, to which he was glad to return at the end of his unhappy holidays. But he had only been two months back at school when his mother and her baby died, and David had to make the long journey by coach to Blunderstone to be present at her funeral. The one comfort in all his sorrow was faithful Peggotty, who hated the Murdstones as much as she had loved David and his mother.

Of course, Peggotty got notice to quit the Rookery as soon as David's mother was buried, for Mr. Murdstone and his sister had only allowed her to remain because of her late mistress having had no other servant all her married life. The Murdstones cared so little for David, however, that they had no objection to Peggotty taking him with her for a time to the home of her brother, Mr. Peggotty, on the beach near Yarmouth. This place was known as the Ark, and a quainter home you could not imagine.

It was just an old wooden vessel turned upside down, with a chimney fixed where the keel used to be. David was entirely charmed with it the first time he saw it.



STEERFORTH MAKES TROUBLE FOR POOR MR. MELL AT SALEM HOUSE SCHOOL

"If it had been Aladdin's palace, roc's egg and all, I suppose I could not have been more charmed with the romantic idea of living in it. There was a delightful door cut in the side, and it was roofed in, and there were little windows in it; but the wonderful charm of it was that it was a real boat which had no doubt been upon the water hundreds of times, and which had never been intended to be lived in, on dry land. That was the captivation of it to me. If it had ever been meant to be lived in, I might have thought it small, or inconvenient, or lonely; but never having been designed for any such use, it became a perfect abode.

"It was beautifully clean inside, and as tidy as possible. There was a table,

and a Dutch clock, and a chest of drawers, and on the chest of drawers there was a tea-tray with a painting on it of a lady with a parasol, taking a walk with a military-looking child who was trundling a hoop. The tray was kept from tumbling down by a Bible; and the tray, if it had tumbled down, would have smashed a quantity of cups and saucers and a teapot that were grouped around the book. On the walls there were some common coloured pictures, framed and glazed, of Scripture subjects. There were some hooks in the beams of the ceiling, the use of which I did not divine then; and some lockers and boxes and conveniences of that sort, which served for seats and eked out the chairs.

"All this I saw in the first glance after I crossed the threshold—child-like, according to my theory—and then Peggotty opened a little door and showed me my bedroom.

THE INSIDE OF THE ARK AND THE QUAINT FOLK WHO LIVED IN IT

"It was the completest and most desirable bedroom ever seen—in the stern of the vessel; with a little window, where the rudder used to go through; a little looking-glass, just the right height for me, nailed against the wall, and framed with oyster-shells; a little bed, which there was just room enough to get into; and a nosegay of seaweed in a blue mug on the table. The walls were white-washed as white as milk, and the patch-work counterpane made my eyes quite ache with its brightness."

And the folk that lived at the Ark were as quaint as their abode. First

WHAT THE ARK WAS LIKE OUTSIDE
Little Emily seated on the beach outside her home.

there was Dan'l Peggotty himself, a tall, burly fisherman, whose heart was as soft as his whole appearance was rough; then there was Ham Peggotty, his orphan nephew, the boat-builder, a great burly young man, just as simple-hearted as his uncle; and Mrs. Gummidge, the widow of Mr. Peggotty's former partner in the fishing trade. Mrs. Gummidge seemed to be the most miserable, moping, grumbling woman in the world. She was always lamenting her uselessness, her "lone, lorn" condition, the fact that she was a burden on Mr. Peggotty, but all the while she did the work of the house splendidly, and kept everything neat and clean, and when great sorrow came to them all, Mrs. Gummidge proved herself a woman of courage and a brave heart. Last, but not least, was Little Emily, the daughter of Mr. Peggotty's brother-in-law, who, like the father of Ham, had been "drowndead." Emily was a beautiful child, and she and David played, rather shyly, perhaps, at sweethearts. She had a great love for her uncle, who loved her better than all the world, and yet she was fated to bring him the greatest sorrow of his life.

THE COSY SCENE INSIDE THE ARK
Here we see Mr. Peggotty, Ham, Clara Peggotty, Mrs. Gummidge, and Little Emily, while David Copperfield is seated on the chair.

When Clara Peggotty brought David here among these simple, good people, he was as happy as he could be, and he clung to them all as his only friends,

DAVID SURPRISES HIS AUNT BETSY
After a week's walk from London he arrives at Dover.

now that his mother was dead. With Emily he attended the very quiet wedding of Clara and Mr. Barkis, the carrier, which took place during his stay at the Ark. Barkis had long wanted Clara Peggotty for his wife, and had really proposed to her through David, by getting him to say to her, "Barkis is willin'!" meaning that when she was ready to marry he was willing to have her. But she would not have married him if her dear mistress had not died. Barkis had a fine little house ready waiting for her, and one of the bedrooms was to be kept for David whenever he wanted it; so that he had a home after all, though the horrid Murdstones had usurped the Rookery. Murdstone's main desire was now to be rid of his stepson, and when David returned to Blunderstone, he found that arrangements had been made for him to be employed in the warehouse of the London wine merchants in which Mr. Murdstone had some interest. His wages would be enough, he was told, to buy his food and clothing, and his lodgings and washing would be paid for by his stepfather. So off the boy was packed to London to make his fortune.

The rat-infested warehouse of Murdstone and Grinby's was on the Thames at Blackfriars, and the work which David was given was of the most menial kind. He was sent to lodge with a Mr. Micawber, then living off the City Road, and thus began an acquaintance that was fated to last for many years. Mr. Micawber was an extraordinary man. In appearance he was tall and of good presence, an extremely large bald head rising like a shining egg out of a most imposing shirt-collar. His clothes were like those of a rather shabby actor. And, indeed, Micawber was something of an actor. He loved to speak in long-winded sentences, full of extraordinary words, and he was always on the point of doing something remarkable—which he never did. He was really a failure in everything, and was in debt to everybody, always promising to square accounts when something turned up, but nothing ever "turned up" with him. His wife boasted of her grand relatives, whom nobody ever saw, and made a great show of her shabby fineries. The Micawbers had four children—a boy and a girl, somewhat younger than David, and two infants who were twins.

DAVID IS HAPPY IN THE SHABBY HOME OF THE MICAWBERS

On the whole, David found the shabby home of the Micawbers not too comfortless, but he suffered great misery at the warehouse, where he toiled as no boy of his age and upbringing should have been allowed to toil, among ignorant, rough men and lads. Mr. Micawber got put in prison for debt, but David was faithful to him, and when Mrs. Micawber and her family also removed into the prison—as they could do in those days—a room near to it was hired for their

A PEEP INTO THE HOME OF URIAH HEEP
David has gone with Uriah to take tea with him and his mother in their "'umble" abode, when Mr. Micawber, in passing, pops in.

young lodger, who had so great a liking for Micawber that he had no wish to be separated from that good-natured, genial, but hopelessly impracticable person. In the course of time Micawber was liberated again, and with his family set off for Plymouth, where his wife's grand relations were supposed to have great influence, and "something might turn up" if he were on the spot.

HOW DAVID RAN AWAY FROM LONDON AND FOUND HIS AUNT BETSY

David parted from them with sorrow, and soon after decided to run away from the hateful bottling warehouse. He wrote to Mrs. Barkis to lend him half-a-guinea, and to tell him if she knew where his aunt, Betsy Trotwood, lived. His dear old nurse sent him the money, but could only say that his aunt lived somewhere Dover or Folkestone way. Even with so vague a destination, David set out, but had not got clear of London before he was robbed of his box and his money; so that he had to suffer terribly before, by dint of much inquiring, he found himself in dirty rags at the door of his aunt's comfortable little house at Dover. The lady was amazed to see the ragged boy, who told her she was his aunt and that his name was David Copperfield. There lived with Miss Trotwood an elderly man named Richard Babley, but better known as "Mr. Dick." He was not quite sane, but Miss Trotwood always declared he had a great deal more sense than he was given credit for, and she often acted upon his advice. She now sent her servant to call him, and asked him what she should do with David.

"Why, if I was you," said Mr. Dick, considering and looking vacantly at David, "I should—I should wash him."

"Janet," said his aunt, "Mr. Dick sets us all right. Heat the bath!"

DAVID'S HAPPY SCHOOLDAYS IN THE OLD TOWN OF CANTERBURY

And so began a new and happy chapter in David's life. Instead of being the sour old woman we might have expected, from her conduct the night David was born, she proved the kindest and best of aunts, and forgave David for being a boy, but made him call himself Trotwood Copperfield in future. He had many happy days with Mr. Dick, whose great trouble was that he could not avoid mentioning King Charles's head in a memorial he was writing out for submitting to the Government. King Charles's head would come in somehow, and then he had to begin all over again. But otherwise Mr. Dick was a quiet and interesting old gentleman, who loved to fly large kites, and he got on excellently with David, whose aunt at length decided to send him to Dr. Strong's academy at Canterbury. She made arrangements for him to board at the house of her lawyer there, Mr. Wickfield, whose beautiful and wonderfully intelligent young daughter, Agnes, looked after the house, Mrs. Wickfield being dead.

David was extremely happy here, both at school and at home, and came to regard Agnes as his chum, to whom he could tell his inmost thoughts. The only person he did not like was Mr. Wickfield's clerk, a young man named Uriah Heep, who forced his acquaintance on David, and always pretended to be very humble. "I am well aware," he said, "that I am the 'umblest person going, let the other be where he may. My mother is likewise a very 'umble person." This fellow really hated David because he and Agnes were such warm friends, and the cringing scoundrel was to cause much trouble to that little household later on.

DAVID'S AUNT CHOOSES A PROFESSION FOR HIM AND FITS HIM OUT

The happy days at Canterbury came to an end, and David's aunt furnished him with money to take him to London, or wherever he cared to go, for a time, as a holiday, during which he might consider what his next step in life was to be. He went to London, and there by chance met Steerforth, for whom all his old admiration remained. That breezy, pleasure-seeking young man accompanied him on a visit to the Peggottys, "just for the fun of the thing," as we say. He pretended to be very interested in all he saw at Yarmouth. David, in the meantime, had thought very little about his next step, and a letter from his aunt decided it. By paying a thousand pounds to the firm of Spenlow and Jorkins, she could get him taken as a pupil in a branch of the law which related chiefly to Church matters and marriages. He might become a "proctor," which was a good paying profession. Steerforth

said it was all right, and David fell in with his aunt's views. When he got back to London, Miss Trotwood made him as cosy as ever a young gentleman was, and engaged most comfortable chambers for him. He soon began to fancy himself quite a young man of fashion, and delighted to entertain Steerforth at his rooms. In his profession he made no great progress; but Mr. Spenlow invited him to his house, and he was at once over head and ears in love with Miss Dora, his employer's motherless daughter, a fragile but bright and lively girl, who also fell in love with him.

Alas! when all seems brightest for our hero, trouble is brewing in many different ways. Uriah Heep gets Mr. Wickfield under his thumb, by preying upon that gentleman's weakness for lingering over the wine after dinner, and manages to implicate him in several swindling transactions. Little Emily is to be married to honest Ham, but she runs away abroad with Steerforth, and there is gloom and mourning among the simple folk at Yarmouth. David aspires to marry Dora Spenlow, but he is suddenly informed by his aunt that she has lost all her fortune, except her house at Dover, which she has let, and is coming to take up her abode with him in London, while Mr. Dick will get lodgings in the neighbourhood. David sees his hope of success as a proctor vanishing, for he can no longer think of going on without earning some money to help his aunt. He cannot get anything of the thousand pounds she paid returned, and presently the firm are proved to be very hard up for money, Mr. Spenlow dying and leaving his daughter unprovided for, instead of an heiress, as most people had supposed. So David has to earn some money as secretary to his old schoolmaster, Dr. Strong, now in London and engaged in the compiling of a dictionary, while he also learns shorthand and becomes a reporter. Mr. Micawber turns up about this time with great prospects, and invites David and Traddles, who is studying for the Bar, and with whom David has renewed his old friendship, to a little farewell party, at which he makes this speech.

"My dear Copperfield," said Mr. Micawber, rising with one of his thumbs in each of his waistcoat pockets, "the companion of my youth—if I may be allowed the expression—and my esteemed friend Traddles—if I may be permitted to call him so—will allow me, on the part of Mrs. Micawber, myself, and our offspring, to thank them in the warmest and most uncompromising terms for their good wishes. It may be expected that on the eve of a migration which will consign us to a perfectly new existence"—Mr. Micawber spoke as if they were going five hundred thousand miles—"I should offer a few valedictory remarks to two such friends as I see before me. But all that I have to say in this way I have said. Whatever station in society I may attain, through the medium of the learned profession of which I am about to become an unworthy member, I shall endeavour not to disgrace, and Mrs. Micawber will be safe to adorn. Under the temporary pressure of pecuniary liabilities, contracted with a view to their immediate liquidation, but remaining unliquidated through a combination of circumstances, I have been under the necessity of assuming a garb from which my natural instincts recoil—I allude to spectacles—and possessing myself of a cognomen to which I can establish no legitimate pretensions. All I have to say on that score is, that the cloud has passed from the dreary scene, and the God of Day is once more high upon the mountain-tops. On Monday next, on

DAVID AND TRADDLES AT MICAWBER'S PARTY

the arrival of the four o'clock afternoon coach at Canterbury, my foot will be on my native heath—my name, Micawber!"

All this simply meant that Micawber was going to be clerk to Uriah Heep at Canterbury, for the villain was now the real head of Mr. Wickfield's business, and, with his "'umble" mother, lived in the house, to the distress of poor Agnes.

DAVID MARRIES DORA AND BEGINS TO WIN FAME AS AN AUTHOR

David was still deeply in love with Miss Dora, and as he was now earning quite a good income by writing, and beginning to win fame as an author, he ventured, with the assistance of Traddles, to propose to the aunts with whom she had gone to live that Dora and he should marry. Before long the aunts gave their consent, and they were married. Dora was still little more than a girl, and she was quite unable to keep house properly. Indeed, she was everything that was charming, except a housewife, and David's home was always in a muddle; while poor Dora played with her little dog, Jip. He had the most lovable of wives all the same, and his only sorrow was to notice that her health seemed to grow feeble, the brightness of her eyes to fade, as the months wore on. He had grave fears for her; but his aunt, who had taken a cottage near his own, watched over Dora with as much loving care as if she had been her own daughter.

Meanwhile, things were going badly with Mr. Wickfield, and Agnes was in great distress, when one day the worthy Micawber called, in a very troubled state of mind, to see David and his aunt. On being asked to explain what was the matter, he did so in his own way.

MICAWBER'S GREAT DISCOVERY AND ITS HAPPY RESULTS FOR ALL

"What is the matter? What is *not* the matter? Villainy is the matter; baseness is the matter; deception, fraud, conspiracy are the matter; and the name of the whole atrocious mass is—HEEP!"

He went on at great length to denounce this villain Heep in his own extravagant way, but, to cut his long story short, it all meant that Micawber had discovered the swindling of Uriah Heep, and had set himself to bring honest people to their own. Thanks to him, Miss Trotwood's lost fortune was largely recovered, Mr. Wickfield was restored to happiness, and Mr. Traddles as a young lawyer had a great deal to do in putting the old business into shipshape again.

Miss Trotwood, out of gratitude for Micawber's service, advanced the money for him and his family to go out and establish themselves in Australia, in the hope that he might find out there the fortune he had vainly expected to "turn up" in England. But the Micawbers did not go alone. In the same boat sailed Mr. Peggotty and Mrs. Gummidge, and with them Emily, whom her uncle still cherished, though she had run away from home and he had to search for her far and wide.

David saw them all sail away, and the night fell darkly on the waters and on him. He next went down to Yarmouth with a letter for Ham, only to be present when the honest young man was drowned in trying to reach a wreck, on which the last man who was washed away was none other than the false friend Steerforth. The shadows were gathering round his own hearth, for poor Dora gradually faded away, until one day she died peacefully in the arms of Agnes Wickfield.

THE END OF THE LONG STORY AND THE GREAT HAPPINESS THAT CAME AT LAST

David Copperfield, who had known all these sorrows, was still a very young man, with all his life's work before him, his fame as an author steadily growing. He wandered abroad in foreign lands for some few years, and when he came back again to England he found his aunt comfortably settled at the old home, with his own old nurse, Peggotty, now a widow, as her companion. Best of all, his spirits began to revive. He found Agnes Wickfield still the same wise, constant woman, and more beautiful than she had been in the dear days when they were young folk together at Canterbury. His aunt managed to show him what he had never before realised, that both he and Agnes loved each other even more than brother and sister, and—so they came to be married!

"I have loved you all my life," said Agnes to David when he had declared his love for her. "And I have one thing more to tell you. On the night that Dora died she left me a last charge. It was that only I should occupy this vacant place."

The next story of BOOKS is on page 2903.

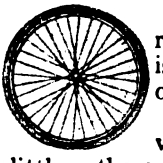
WHAT THIS STORY TELLS US

THE eighteenth century was near its close when men first tried to invent a bicycle; but it was not until 1885 that the pastime became one in which children and all could share. Up to 1885, the bicycles had been of strange shapes. The first were called hobby-horses. They consisted of two wheels of the same size, joined together by a metal backbone, on top of which was a saddle. The rider had to seat himself on this saddle, and had to balance himself by touching the ground with his feet, and, by a sort of tiptoe running action, make the bicycle go along. The first improvement upon this was when two clever Scotsmen invented pedals and cranks which drove the front wheel. From that we got to what was called the "bone-shaker." It was a bicycle a little larger than the present-day safety; but the wheels were of wood and the tires were of iron. This story tells us how we got the bicycle we all know, and the pictures show us how it is made.

HOW WE GOT THE BICYCLE

CONTINUED FROM 2732

THE bicycle that men rode until almost our own time was called the "ordinary" bicycle, and we still see one in the streets sometimes. The "ordinary" was the bicycle with a big wheel in front and a tiny one behind. The front wheel was from four feet to five feet high, while the little one was from ten inches to eighteen inches high. For this bicycle, solid rubber tires had to be used. Men could ride over twenty miles an hour on it. The great objection was that from this bicycle one had so far to fall.



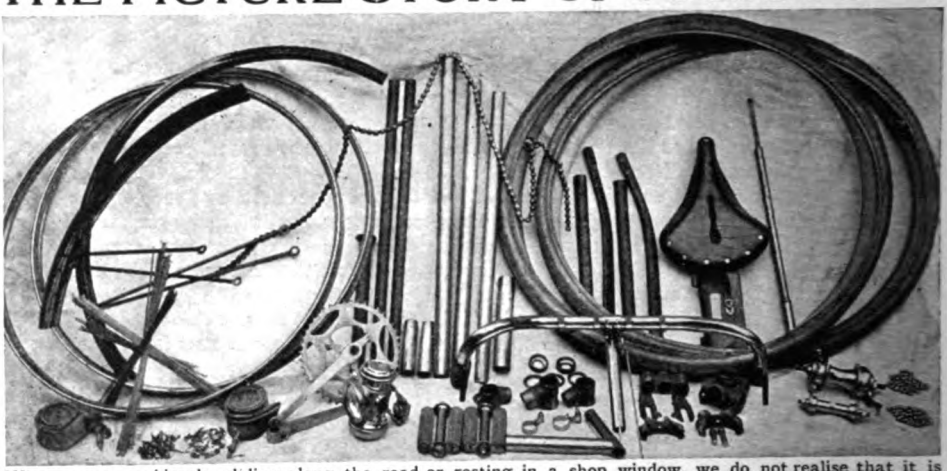
It was in 1885 that two Englishmen named Starley, of Coventry, made the first safety bicycle. That is the kind of bicycle that we all use to-day. The difference between the modern bicycle and the old "ordinary" is that the wheels of the modern machine are small and of the same size, and the driving power is applied in a different way.

The old "ordinary" bicycle was driven by pedals which were fixed by cranks to the hub of the front wheel. Starley made his mechanism drive the back wheel, but not by fixing the pedals to the wheel itself. The pedals drive a cogged wheel, around which a chain runs. The chain causes a smaller wheel to revolve, and this wheel, being part of the back wheel, makes the bicycle wheel go round and carry us along. All that the front wheel has to do is to bear part of the weight, and to respond to the steering influence of the handle-bar. The shape of the safety bicycle has been greatly improved upon in recent years, but the principle is the same as in the first safety of a quarter of a century ago.

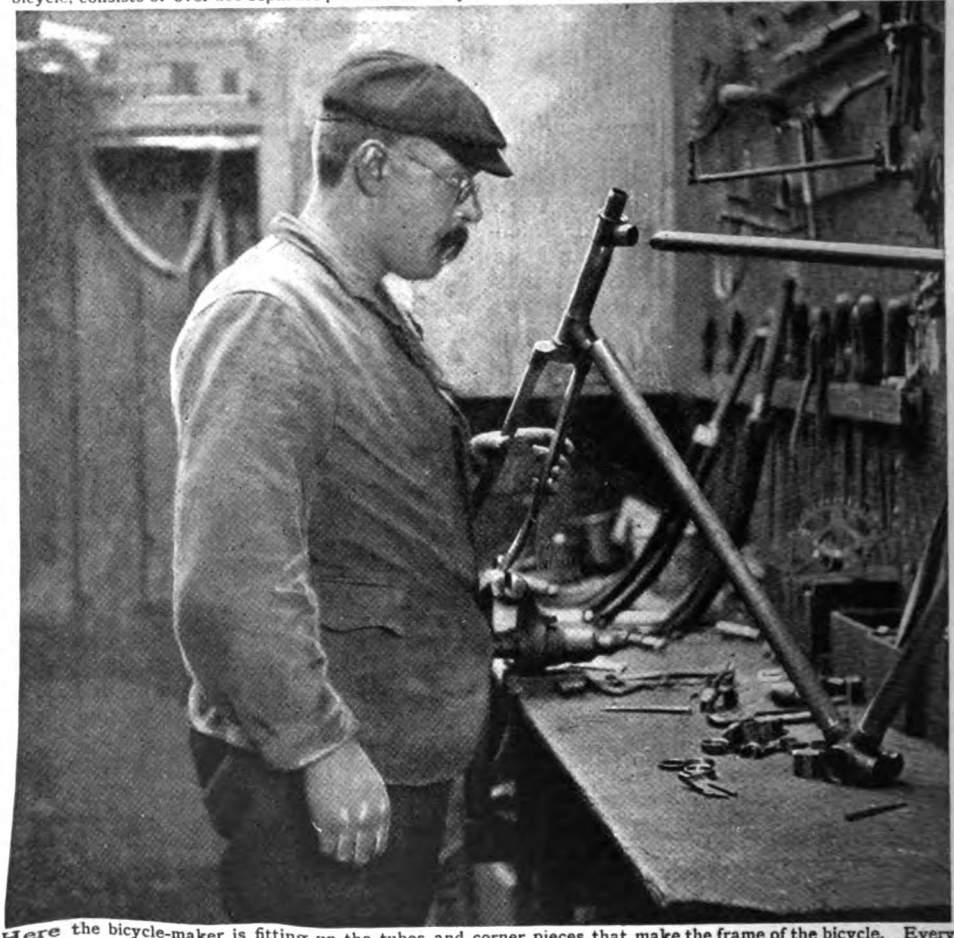
The shape of the bicycle was very important, but that was not the only thing to make the machine popular. A Belfast veterinary surgeon, named Dunlop, made the final great improvement—and that was in the tires. The old safety, with its thin tires of solid rubber, used to cause the most dreadful jarring. On getting home after riding over the cobbly roads of a town, one's hands and arms would feel almost paralysed from the constant vibration. What Dunlop did was to give us the pneumatic tire. This consists of a rubber tube which is blown up hard with an air-pump, and is made safe by being enclosed within an outer case of tough rubber.

The final improvement of the bicycle was the invention of what is called the "free wheel." This is a wheel so planned that it only works when the pedal is being driven forward. When we are riding on the level or uphill, we push the pedals down and round. When we descend a hill, we hold the pedals stationary with our feet. The free wheel immediately comes to rest, and the rear wheel of the bicycle, to which it is attached, runs free, so that we can descend a hill at our ease without removing our feet from the pedals.

THE PICTURE STORY OF A BICYCLE

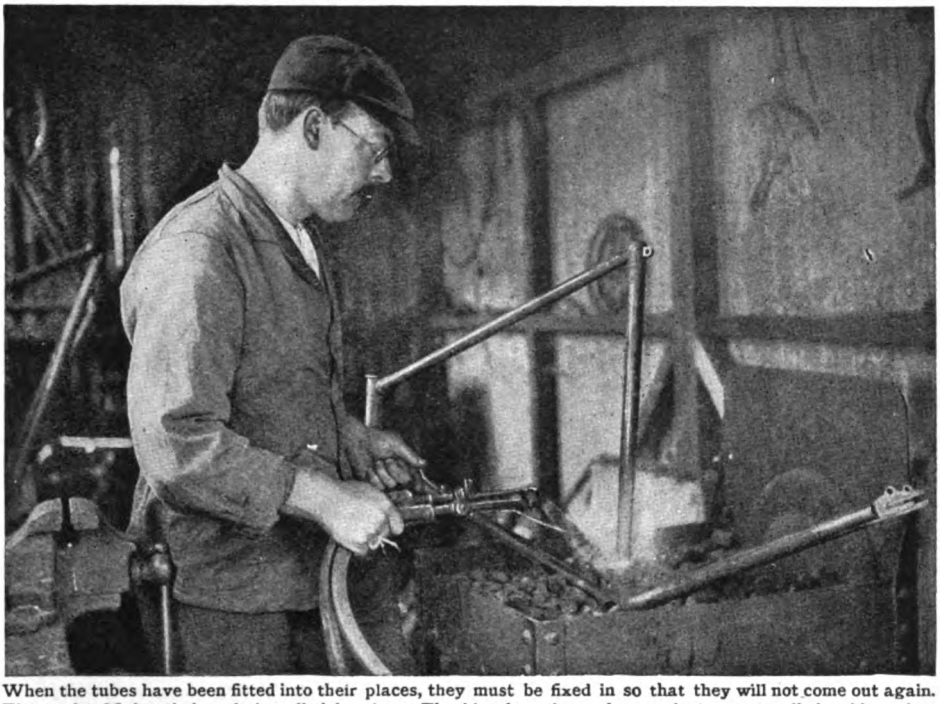


When we see a bicycle gliding along the road or resting in a shop window, we do not realise that it is made of very many parts—some big, some small. Yet the whole of the material, before it is made into a bicycle, consists of over 300 separate pieces. In this picture we see the many parts that go to make a bicycle.



Here the bicycle-maker is fitting up the tubes and corner pieces that make the frame of the bicycle. Every tube must be cut to exactly the right length for its special place, and must be fitted with its end tightly in the "lug," or corner piece, to which it has to be attached. Unless the pieces fit well the bicycle will not be strong.

HOW THE FRAME OF A BICYCLE IS MADE

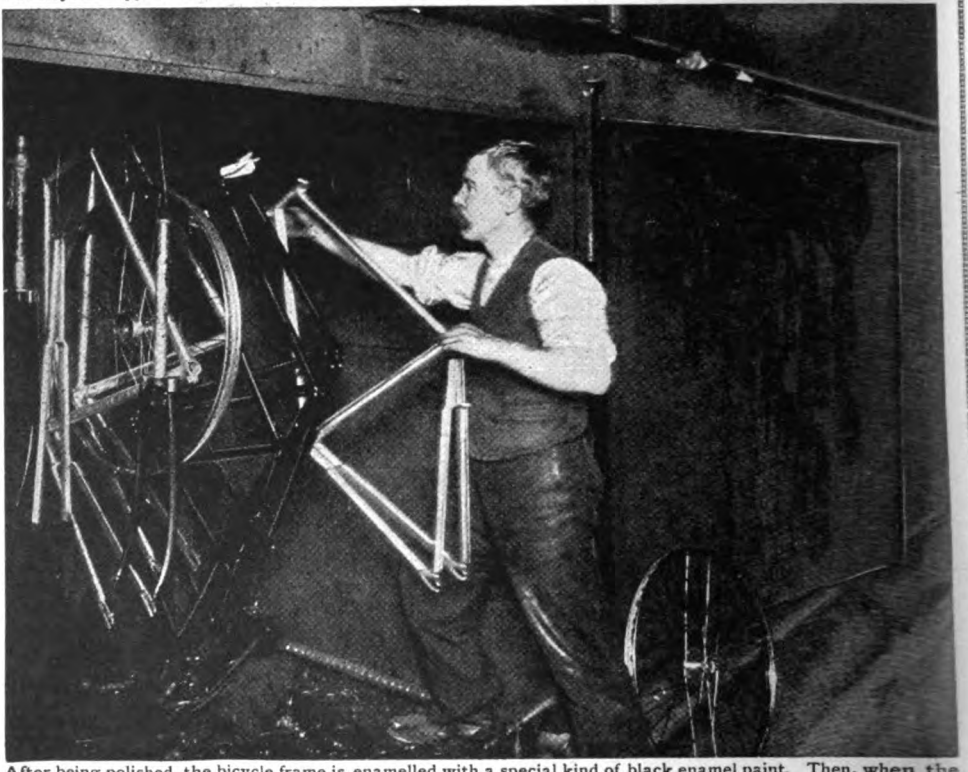


When the tubes have been fitted into their places, they must be fixed in so that they will not come out again. The work of fixing their ends is called brazing. The bicycle-maker takes an instrument called a blow-pipe, which has two tubes—one admitting gas and the other air. The gas is lighted and an air-pump or bellows working through the other tube blows the flame upon the part of the bicycle near which the man holds it. This makes the bicycle red hot at the place, and tiny pieces of brass, called brazing spelter, mixed with borax, are put into the joint. The heat melts the brass, which runs between the parts, "gluing" them together, as it were.

The heat and the melted brass have made the joint of the bicycle rough and ugly. A bicycle is meant to be a thing of beauty as well as a thing of use, and the rough places must be made smooth. In this picture a newly-made joint is being filed down by the bicycle-maker. This is the first operation in the process of polishing.

PUTTING THE BICYCLE INTO THE OVEN

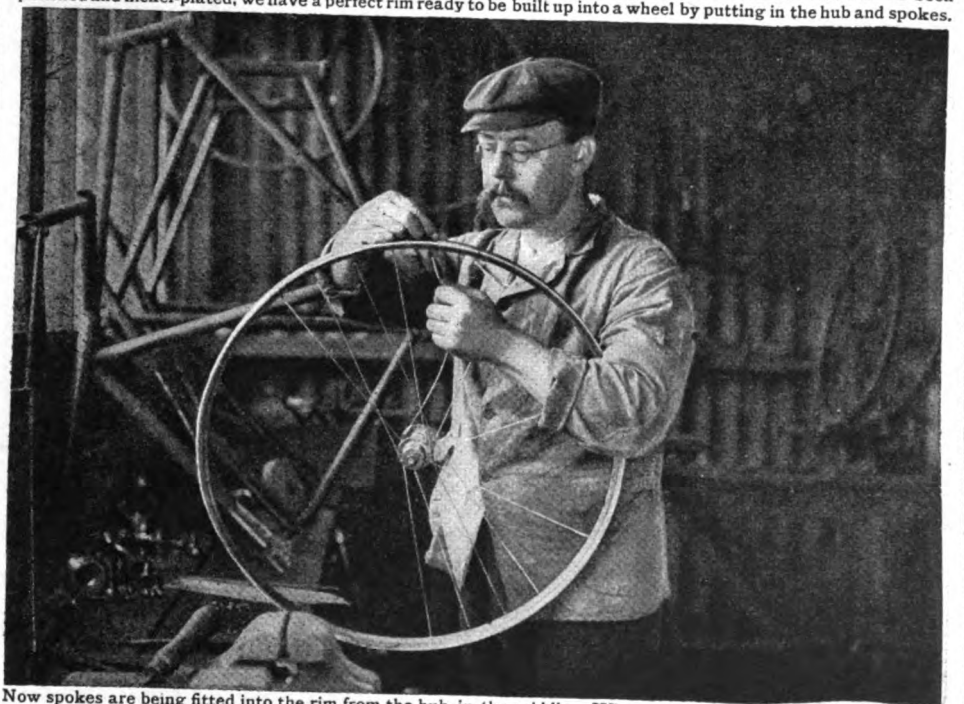
A bicycle frame must be highly polished if the bicycle is to look well when it is finished. We have often admired the beautiful glossy black of a new bicycle. The handsome gloss is possible only because the steel has been carefully polished before the black coat was put on. This polishing is done by pushing the bicycle against very rapidly revolving wheels, some of which are covered with emery, some with leather, and some with cotton or felt. The bicycle is applied to these wheels one after the other, as seen in this picture, until it shines like brilliant silver.



After being polished, the bicycle frame is enamelled with a special kind of black enamel paint. Then, when the enamel is still wet, the frame is put into a great oven, such as we see here. The oven is heated by gas-jets. When the oven door is closed, and the gas-jets are lighted, the heat dries the enamel on the frame very hard. Then the frame is taken out, rubbed smooth with paste, and enamelled and heated in the stove again. Yet again it is rubbed and stoved, and finally we get the beautiful black gloss that we see on a new bicycle.

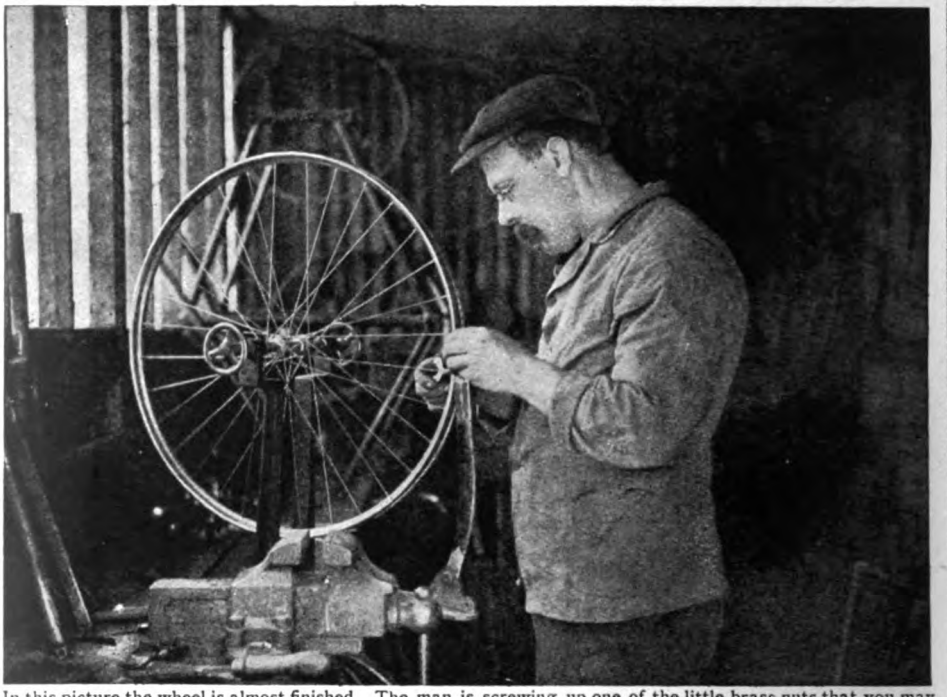
THE SHAPING OF THE BICYCLE WHEELS

This man is making a bicycle wheel. A flat piece of steel has been put into a special machine, which we do not see here, and made into the circular shape necessary for a wheel. The two ends are fitted together carefully, as we see being done here, and the joint is brazed in the same way as the joints of the frame. After it has been polished and nickel-plated, we have a perfect rim ready to be built up into a wheel by putting in the hub and spokes.



Now spokes are being fitted into the rim from the hub in the middle. When all the spokes have been put in, and screwed to the proper length so as to make the rim true and free from wobbling places, and when the wheel has been enamelled and dried in the stove, it is ready to be fitted into the frame, which we have already seen made.

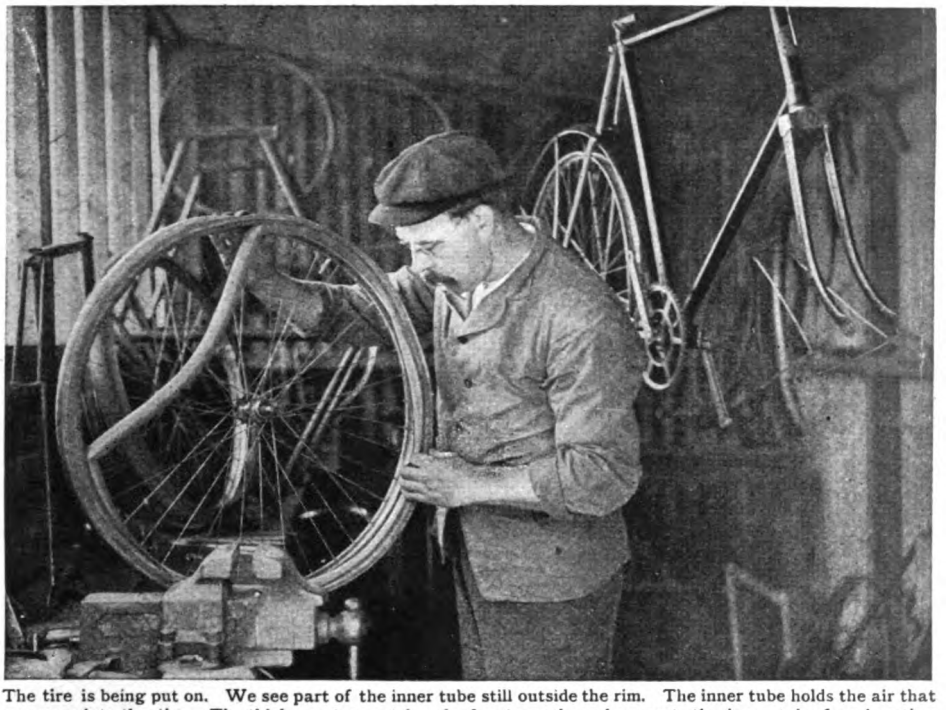
MAKING THE WHEELS RUN TRUE



In this picture the wheel is almost finished. The man is screwing up one of the little brass nuts that you may see at the rim end of a bicycle spoke. The wheel is in what is called a trueing frame, which enables the bicycle-maker to see if the rim has any wobbles or not. If he finds that at one place the rim has a wobble to the left, he screws up a right-side spoke so as to pull the rim true. By going carefully round every spoke he makes a true wheel.

Here the back wheel has been fitted into the frame, which has already got the handle-bars and brake fittings, also the chain-wheel and cranks. The small picture put in the place of the front wheel shows the inside of a hub with the ball-bearing, which makes the bicycle run so smoothly. The ball-bearing was a very valuable invention.

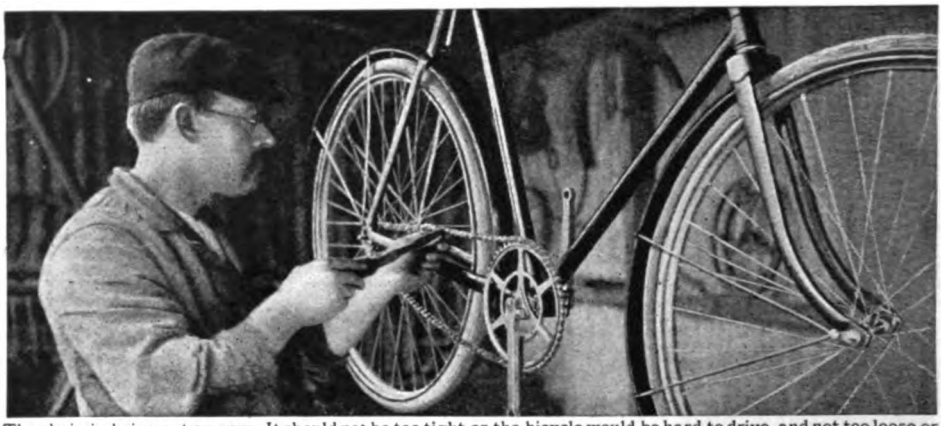
THE TUBES OF AIR ROUND THE WHEELS



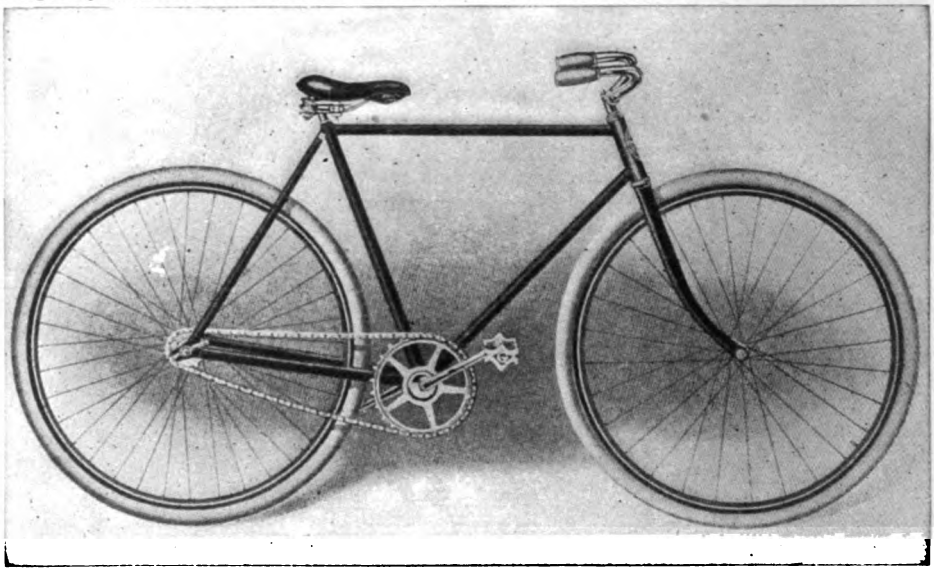
The tire is being put on. We see part of the inner tube still outside the rim. The inner tube holds the air that we pump into the tire. The thicker outer part is only for strength, and prevents the inner tube from bursting or from puncture. After the tire is on the wheel, the valve is put into place and the tire is ready to be inflated.

The tire is being blown up, or "inflated," as we say. It should be blown up pretty hard. and, as this is being done, it should be seen that the inner tube is not sticking out from under the edge of the cover, or it will be cut.

THE BICYCLE IS READY TO GO



The chain is being put on now. It should not be too tight or the bicycle would be hard to drive, and not too loose or it might slip off the teeth of the wheels as we ride. Observe that the pedals have not yet been fitted to the cranks.



Here we see one of the latest types of bicycles finished and ready for riding. The saddle is in place, the pedals are fixed, tires are inflated, and the wheel is in revolving order. At last we have the finished article.

Every bicycle in this group of girl cyclists has gone through the many processes we have seen in these pictures, and more. And now, as we can enjoy cycling through country roads and lanes, it will give us a new interest in our bicycle that we know something about how it was made in the bicycle factory from the mass of steel fittings.

THE NEXT FAMILIAR THINGS BEGIN ON PAGE 2975

THE STORY OF PETER PAN

WE all love Peter Pan, the boy who will not grow up. Nobody knows how young he is or how old he is; all that Mr. Barrie, who gave him to the world, knows, is that Peter Pan is ever young, ever happy, ever hopeful. He is the spirit of Youth and Joy, and he was introduced to the world in 1902 by Mr. J. M. Barrie, who found him hiding in the recesses of a marvellous imagination. Mr. Barrie, with his wonderful mind, has given us many books that men and women read with great delight, but he will be remembered by children for all time as the man who gave the world Peter Pan. Every year Peter Pan comes to New York, with Wendy and the lost boys, to tell their story in a theatre, and if we want to be very, very happy we cannot do better than go to this theatre about Christmas-time, when we shall get to love Peter Pan with all our hearts.

HOW PETER FOUND HIS SHADOW

CONTINUED FROM 2745

THERE was once upon a time a little girl named Wendy Moira Angela Darling. She lived in a house with her brothers, John Napoleon Darling and Michael Nicholas Darling. This house was an ordinary house of brick and slates, but one thing about it was quite extraordinary. It contained a Newfoundland dog whose name was Nana, and this dog acted as nurse to the three children.

Nana was so clever that he never allowed the children to put on a flannel nightdress before it was aired at the fire; and he knew how to turn on the hot water when it was bath-time; and however the children might cry that they would *not* be bathed, or that they would *not* go to bed, Nana always insisted that they should.

Now, Mrs. Darling loved Nana, and she had a particular reason for keeping this brave and powerful dog as the children's nurse. One night, on visiting the nursery, she had seen a strange flitting shape moving quickly to and fro in the dim glow of the nightlight. At sight of Mrs. Darling this shape rushed to the window. Mrs. Darling darted towards it. Just as it sprang into the night Mrs. Darling pulled down the window with a bang. The shape escaped; but something fell on the floor at Mrs. Darling's feet. *It was the shadow of this strange, flitting creature.* Mrs. Darling put the shadow in a drawer; but she felt very nervous for the safety of the children. She feared that the shape might come back and do them some dreadful harm. The only comfort she had was the presence of Nana in the nursery. The big dog, she thought, would protect her children from all danger. But one night Mr. Darling was rather cross, and he said it was ridiculous to have a dog for a nurse; and he got so cross at last that he said Nana should sleep in a kennel in the yard. Mrs. Darling pleaded; the children cried; Nana barked. Mr. Darling, however, was extremely cross, and Nana was led away to the yard, moaning and growling.

That night the window was thrust open, and into the room glided and skipped the mysterious shape.

"Where is my shadow?" it cried; while Nana barked furiously outside. "I can't be happy without my shadow. Tinker Bell, Tinker Bell, where is my dear little shadow?"

Instantly a spot of light flicked into the room, and sprang round the walls, and over the ceiling, and down the beds, and across the carpet, making a tinkling sound wherever it flitted and whenever it settled for a moment. This was the fairy Tinker Bell, a little female fairy. She told the Shape where the shadow lay, and soon the drawer was open, the shadow pulled forth, and the Shape skipped round the room with delight, singing, dancing, laughing in its joy, while Tinker Bell

flashed round the room like a luminous butterfly. But, alas! when the Shape tried to make the shadow stick on, it refused, and so all the delight went, and the Shape burst into passionate tears.

Just at this moment Wendy awoke. She was not frightened, and asked the little Shape why it was crying. Then she asked it its name, and the Shape told her that it was Peter Pan. Wendy got needle and thread and stitched the shadow on to Peter Pan. and then Peter Pan danced with joy, for wherever he went the shadow followed him on the floor.

Peter Pan then told Wendy his story. He said that he lived in a place called Never-Never-Land, with a lot of little boys who had all been dropped out of their perambulators by careless nurses; and that they lived with fairies and would never grow up, but for always and always would remain happy boys in this enchanting Never-Never-Land.

He told her that when the first baby laughed, the laughter broke into little pieces, and each little piece became a fairy, and went dancing about the world. But whenever a child says that it does not believe in fairies, then one of the fairies dies. Peter Pan said it was dreadful for a child to say it did not believe in fairies. There was only one other thing that made them sad, he said, and this was the want of a mother; all the boys in Never-Never-Land wanted to have a mother very much indeed. Wendy asked if there was not a little girl among them who could pretend to be their mother; but Peter Pan shook his head and answered that *girls* never dropped out of their perambulators, they were far too clever. This pleased Wendy, and she loved Peter Pan.

"Oh, Wendy," cried Peter, "come and live with us and be our mother!"

The two boys woke up. Peter Pan said he would teach them all to fly if Wendy would only come and be their mother. All this time Tinker Bell was tinkling angrily, and telling Peter Pan to come away at once. Tinker Bell loved Peter Pan, and was jealous of Wendy.

When the children heard that they could learn to fly, they were quite excited, and immediately began to spring in the air. But every time, they fell and sprawled on the ground, or bumped flat on the beds.

"You must think beautiful thoughts," cried Peter Pan; and, so saying, soared up gracefully into the air, and sailed noiselessly round the room.

Soon the children learned, and all began to fly round the room with cries of delight. Then the windows opened wide, and Peter Pan led the way into the night; and while Tinker Bell tinkled loudly and Nana barked warningly, the children soared towards the stars.

THE LOST BOYS IN NEVER-NEVER-LAND

THE boys in Never-Never-Land were beginning to get anxious about Peter Pan, who was their captain. He seemed to be a long time away, and they were frightened of wolves and pirates. While they were wondering what had happened to Peter, they saw what looked to them like a large white bird in the sky.

As they gazed at it, Tinker Bell suddenly shone on the trees, and, tinkling very loudly, told them that Peter Pan wanted them to shoot this bird at once. So they ran and got bows and arrows, and shot them into the air. Suddenly down fell—what do you think?—poor Wendy with an arrow in her breast. Jealous little Tinker Bell was responsible for this awful deed.

But she was not killed. Soon she revived, and then with her brothers round her, and Peter Pan holding her hand, she promised all the boys to be their mother. Then they set to, and built Wendy a funny little house, with the silk hat of John Napoleon Darling for its chimney-pot; and everybody was wonderfully happy, except Tinker Bell, who was more and more jealous of Wendy.

Now, while they were so happy in their house, through the wood came the terrible pirates. The captain of this frightful gang was named Captain James Hook, and a more horrible villain never froze the blood in a child's veins. All his crew feared him and cowered before him. His long black hair was enough to make you shiver; his yellow skin made you go white; his coal-black eyes struck daggers of fear into your heart; but, far worse than all these, more awful even than his cackling laugh and his way of rolling his "r's" so that they

THE BOY WHO WOULD NOT GROW UP

THE DARLING FAMILY AT HOME, SHOWING MICHAEL ON HIS FATHER'S BACK

PETER PAN COMES IN AT THE WINDOW TO LOOK FOR HIS SHADOW

THE LITTLE HOUSE THAT THE LOST BOYS BUILT FOR WENDY IN THE WOODS

sounded like pistols, was his right hand. His right hand wasn't a hand at all, *it was an iron hook*. How he came to have that hook is part of the story.

Peter Pan had tripped the terrible pirate into the sea, and a crocodile, a tremendous *c-r-r-r-r-rocodile*, had snapped off his hand and part of his wrist. Nor was this all. The crocodile enjoyed the captain's hand and wrist so much that it wanted more, and so it haunted the captain wherever he went, longing to eat another bit of him, and dreaming of the happy day when it would gobble him all up. The captain always knew when his ferocious enemy was near, because on one occasion it had swallowed an alarm clock, and the ticking of this clock could plainly be heard through its skin. But the captain feared, because he knew the clock would one day run down, and then the crocodile would be able to steal upon him unawares.

You can imagine how this pirate hated Peter, the cause of all his troubles, and how he longed to slay him.

One day, when some friendly Indians were guarding the boys, up came the pirates and made a great slaughter of the poor redskins. The boys did not hear the battle, for they were very interested in something that Wendy was telling them underground.

Wendy, you must know, had become the mother of these boys, and they all did exactly what she told them, and all adored her, because it was so delightful to have a mother after having lived so long without one. After she had seen mermaids and a bird that gave up its nest for Peter Pan to use as a boat, she settled down to be a real practical mother, giving the boys their medicine, teaching them how to behave nicely, and tucking them all up nice and comfy in their beds. Considering that she was only nine years of age, Wendy made a splendid mother.

PETER PAN SAVES THE CHILDREN FROM THE PIRATES

Well, on this night, Wendy was telling them a story about her own father and mother—a beautiful story which showed how that mother and father must be weeping for their lost children. As she was finishing, John Napoleon and Michael Nicholas sprang up in their beds, and said :

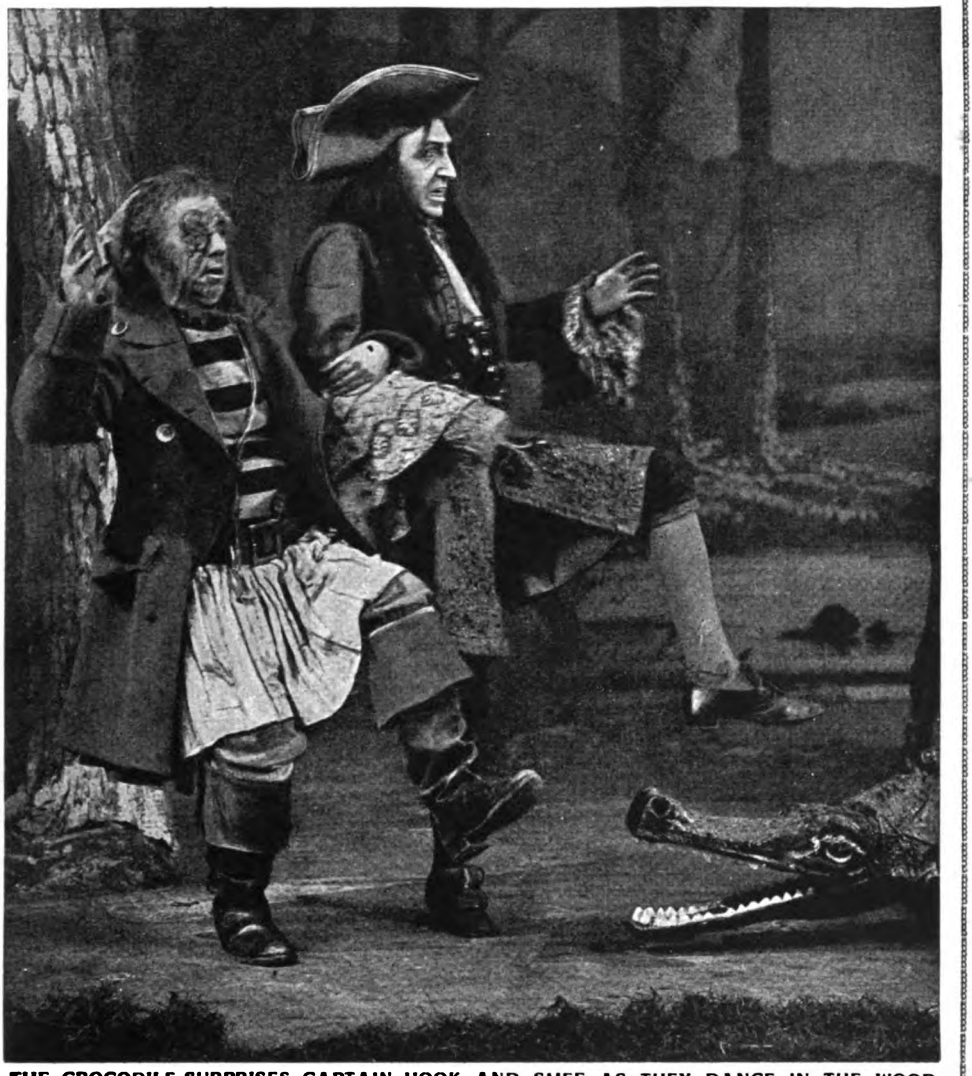
" Wendy, we must go back ! "

" Yes," answered Wendy, " we must go back."

You can imagine how dreadfully sad all the motherless boys were when they

heard that Wendy was going home. They cried so much that at last she told them they might come back with her and her brothers, and live in their house, and have Mr. and Mrs. Darling for their father and mother. All the boys accepted this offer with delight except Peter Pan.

So they all said good-bye to Peter Pan, and one by one went up the narrow tunnel which led from their underground home to the forest and the night. Wendy was the last to go, and before she went she poured out some medicine for Peter and made



THE CROCODILE SURPRISES CAPTAIN HOOK AND SMEE AS THEY DANCE IN THE WOOD

Peter Pan said he did not want to grow up. He did not want to live in a real house and go to school. He wanted to live always in Never-Never-Land, with the fairies and birds and mermaids. In his heart he was terribly sad at losing Wendy, whom he loved very much indeed; but he refused to go away and grow up like an ordinary boy.

him promise her that he would take it when he woke up in the morning.

But instead of kind redskins keeping guard, the pirates were there. The boys were seized one by one as they stepped on ground; a rough hand was clasped over their mouths to prevent them from crying out, and they were carried away prisoners to the pirate ship with Wendy.

HOW THE CHILDREN WENT HOME AGAIN

PETER PAN lay asleep in his bed. The rest of the boys were on board the pirate ship. Peter Pan was alone, and asleep.

Captain Hook was creeping to the hole above. Now was his chance to slay his enemy.

Noiselessly the pirate chief crept down the hole. He arrived at the door, and peeped over the top. Peter Pan was fast asleep. He tried to open the door, and failed. Again and again his hook fumbled at the latch, but failed. Peter Pan was safe. But no! The terrible captain espied the glass of medicine left by Wendy on a shelf; he reached towards it, and then, taking a bottle of poison from his pocket, poured the contents into the glass.

Peter Pan woke up. He remembered his promise to Wendy, and went to drink the poison. At that moment Tinker Bill rushed in, crying:

"Don't drink! Don't drink!"

But her warning was useless.

"I have promised Wendy," answered Peter, and walked towards the glass with his hand outstretched.

In vain did Tinker Bell warn him; but, just as Peter was about to drink, the little Shining Light popped into the glass and drained all its deadly contents. Then it flickered and paled and drooped towards its bed, dying.

Peter knew there was only one way in which he could possibly save it.

"Do you believe in fairies? Oh, please say you believe in fairies!" he cried to all the world. And back from the world, which was so sorry for poor little Tinker Bell, came the answer:

"We believe in fairies."

So Tinker Bell revived and was saved, and she told Peter Pan how the pirates had carried off the lost boys, with Wendy and her brothers, to their ship, and of the danger in which they stood.

Peter immediately started out. He arrived at the ship just as the captain was going to flog his prisoners before making them walk the plank. Peter Pan had an alarm clock in his pocket; he took it out, and at the first sound of that *tick-tick* the captain gave a great cry of horror, thinking that the cr-r-r-rocodile was near.

During the panic, Peter stole on board ship and hid himself in the cabin where the cat-o'-nine-tails was hidden.

The clock ran down. The captain grew brave again.

"Go and get the cat-o'-nine-tails!" he ordered.

One of the ruffians went to obey. As he entered the cabin a terrible shriek resounded all over the ship. Another pirate was ordered to go and see what

THE CHILDREN COME HOME, AND FIND THEIR FATHER SLEEPING IN NANA'S KENNEL

The photographs of "Peter Pan" are taken by Messrs. Ellis & Walery.

had happened. He, too, uttered a ghastly shriek, and did not come out.

The rest of the crew were now in a state of panic. They refused to enter the cabin; one threw himself into the sea.

Suddenly Peter Pan rushed out, sword in hand, and a terrible fight followed. Captain Hook was flung overboard, where the crocodile was waiting for him; and all the rest of the wicked pirates were killed.

Then Wendy and all the boys went home, and you can imagine how glad Mrs. Darling and Mr. Darling and Nana were to see their lost children. Mr. Darling, we must tell you, had been so repentant for his crossness that he had made Nana live indoors and dine at the table and occupy his own chair; while he himself slept in a kennel outside, and ate all his meals out of a dog's trough. Mrs. Darling had always kept the window open, hoping that the children would return; and used to play and sing "Home, Sweet Home," thinking that they might hear her and come back.

But Peter Pan, all alone in Never-Never-Land, longed for little Wendy; and Mrs. Darling allowed Wendy to go every now and then to visit Peter, and see that his house was nice and tidy. Peter Pan always refused to grow up, and Wendy never forgot the fairies.

THE FABLES OF ÆSOP THE SLAVE

THE LAWYER AND THE PEARS

A LAWYER was once invited to a wedding feast in a house some distance from his own. As he walked along the road, he came across a small basket of ripe pears lying beside the path. He was hungry enough to have eaten them for his breakfast, but was looking forward to the feast and did not want to spoil his appetite; so he gave the pears a kick and sent them into the muddy ditch.

Some distance farther on he had to cross a small river; but it was so swollen by the recent rains that the little footbridge had been washed away, and there was no boat to be seen.

So at last the lawyer had to give up all hope of crossing the stream, and turned back to go home. He was now so hungry that when he came to the muddy pears lying at the bottom of the ditch he was glad to get them out, wipe them as well as he could, and satisfy his hunger with them.

Waste not, want not.

THE DOG AND THE ASS

A LARGE dog and an ass, loaded with bread, were going on a long journey together. Both at last grew very hungry, and the ass stopped to eat the thistles by the roadside. This made the dog feel more hungry still, and he begged for a piece of bread from the donkey's load

But the ass answered that, if he was hungry, he must find his own food by the wayside, too, for there was no bread to spare.

Just then a wolf was seen in the distance coming towards them. The ass at once began to tremble, and told the dog that he hoped he would stand by him and protect him if the wolf attacked him.

"No," said the dog. "People who eat alone will have to fight alone."

So he left his fellow-traveller to the mercy of the wolf.

If you want to have friends, you must show yourself friendly.

THE HORSE AND THE ASS

A HORSE and an ass were travelling along a road together, with the man who owned them following behind. The horse had nothing on his back; but the ass was so heavily loaded that he could hardly keep moving. So he begged the horse to help him by carrying part of his burden.

The horse was ill-natured and selfish, and refused to do anything to help, with the result that presently the poor donkey fell exhausted in the road and died there. The owner of the two animals tried to relieve the ass, but it was too late. So he took the whole of the burden and laid it upon the horse's back, together with the skin of the dead donkey; and thus the horse, through his selfishness in refusing to do a small kindness, only brought upon himself a great deal of work and trouble.

We never gain anything by being selfish and unkind.

THE NEXT STORIES BEGIN ON PAGE 2929

THE FIERCE INVADERS OF AUSTRIA

The Hungarians of to-day are descended from fierce, cruel warriors like those shown in this picture, who swooped down upon Europe in the ninth century and destroyed everything in their path. After a time these Magyars, as they were called, became Christians, and they are now the most important people in the Austrian Empire.

Although Austria joined with Prussia and Russia in 1772 to slice up the kingdom of Poland, it was only ninety years before that Austria was saved from destruction by the Poles. The Austrian Empire was overrun by a fierce Turkish army, which was on the point of capturing Vienna, when John Sobieski, the gallant king of Poland, appeared on the scene with an army, relieved the capital, and drove the Turks out of the Austrian dominions. Here we see the Polish troops with their prisoners after they had beaten the Turks and captured their camp.

Rudolph of Hapsburg chosen to head the German states as Holy Roman Emperor in 1273

AUSTRIA-HUNGARY

THE EMPIRE OF MANY RACES

CONTINUED FROM 2756

In the story of Germany we saw the immense importance of the great south to north highway of Europe—the noble river Rhine. Let us now turn to the great west and east highway — the mighty Danube. It is twice as long as the Rhine, for there is a course of nearly 2,000 miles between the bubbling spring of its source in the Black Forest and the delta of many mouths in the Black Sea. Some 400 tributaries join it on this long journey from west to east—little rills in the Black Forest, icy streams from the snowy masses of the Alps, full swelling rivers from the great circle of the Carpathians, besides those rivers that drain Roumania and Bulgaria.

From the earliest times, the old peoples of the world pressed out of Asia into the heart of Europe, chiefly by the great highway of the valley of the Danube. There were the old Celts, who passed on westwards; the early Teutons; and the later hordes who destroyed the old Roman Empire. The Danube was the empire's chief boundary on the north, and to this day there are beautiful and interesting remains in its neighbourhood, as there are along the Rhine. Later there were other invaders perpetually on the highway of the Danube, whose name was a byword and a threat of terror, so that, even in our own day, men speak of an unmanageable person as a "thorough Turk." It was towards the end of the seventh century, when the great Charlemagne was gathering the rule of Christian Europe into his strong hand, that a province grew into shape on the Danube, near the end of the Eastern Alps. This was the East Mark, or boundary of Charlemagne's empire, the eastern outpost of the German peoples for ever fighting back the oncoming Slav races from the east and north-east. This province is still called the East Kingdom, for that is the meaning of Œster-reich, or Austria, and from the kernel of the two states of Upper and Lower Austria on the Danube, the dominions of its rulers have gradually spread over the kingdom of Bohemia and Moravia to the north, over the mountains that shut in Bohemia to a strip of country beyond the northern slopes of the Carpathians, now called Galicia. Southwards, too, the dominions have spread, taking in the Tyrol, the Eastern Alps, and the provinces between the Danube and the Adriatic.

For 600 years the story of Austria has been the story of the dealings of a family, the family of the Hapsburgs,

with their neighbours. When Rudolph of Hapsburg, in the thirteenth century, was chosen by the electors to head the German states as Holy Roman Emperor, few guessed the resolute character of the man who was to do so much towards restoring law and order, and in establishing the fortunes of his house. In the story of Germany we have read of the extraordinary rise to power of his descendants, of Maximilian, of Charles V., and many others, and how by conquest, by treaty, by marriages with heiresses, they gained the Tyrol, the Netherlands, and Spain with its golden empire across the ocean.

THE LONG AND BITTER STORY OF THE HOUSE OF HAPSBURG

With some exceptions, the title of Holy Roman Emperor remained with the Hapsburgs, which caused them to be much mixed up with the Pope and the kingdoms and duchies in Italy. Unhappily, the connection with Spain, always fervently Roman Catholic, nourished in Austria a very bitter spirit with regard to the Reformation, and during the terrible Thirty Years War the Hapsburgs were chiefly to blame for the prolonged ruin and misery spread over Germany.

Bitter and cruel have been the persecutions practised by the House of Austria, both in the matter of religion, and in the destruction of old rights and liberties, in the states that fell under their despotic and narrow rule. Spain and the Netherlands long since passed into other hands; Austria has now no place or voice in Germany, no footing in Italy, only a small but very valuable piece of sea-coast on the Adriatic. We read on page 2530 how the French Revolution and Napoleon together caused the downfall of the Holy Roman Empire, and how the ruler of Austria took the new title—Emperor of Austria—before he laid down the old one.

THE STRUGGLE OF THE BOHEMIAN PEOPLE FOR FREEDOM AND INDEPENDENCE

Bohemia was settled by a Slav people called the Czechs, and developed into a kingdom a century earlier than the formation of the East Mark, and eventful indeed have been its relations with the neighbours all round it. Bad kings and good kings succeeded each other, whose power rose and fell. Now Austria was subject to Bohemia, now to Silesia and the other country beyond the mountains, Poland. Then all was reversed, and Bohemia had a hard fight for existence. In the fourteenth century came the beginning of the struggle about religion, which raged round Wyclif in England and Huss in Bohemia. A gentle and good princess, Anne of Bohemia, travelled at the end of the fourteenth century across the thick forests and heaths of the north plain of Germany, and then faced the waves of the North Sea to reach England. Her effigy lies beside that of the husband who loved her so dearly, Richard II., among the circle of "Royals" in Westminster Abbey. It is said that Anne did much to help the rise of the Reformation.

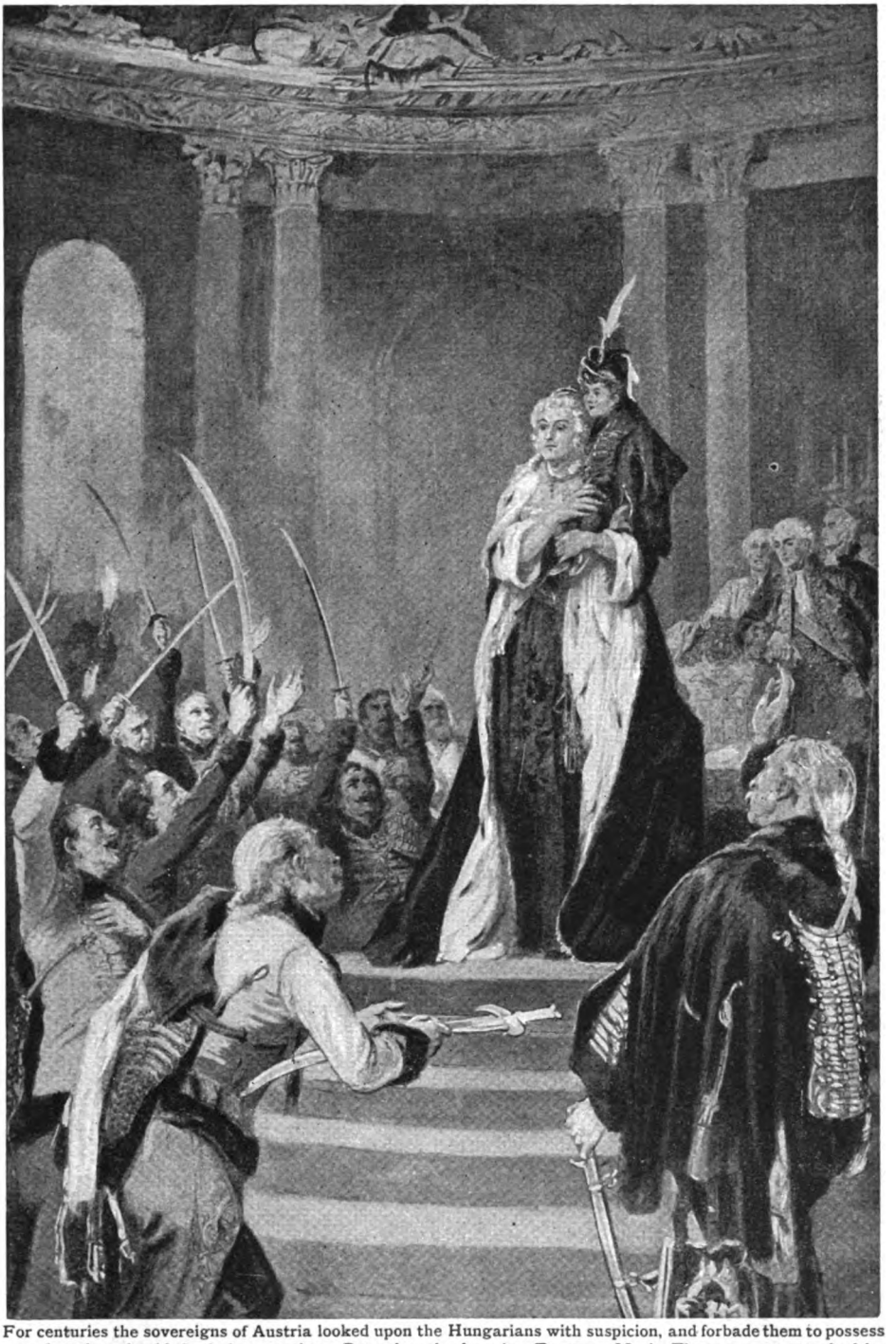
Long and gallant were the struggles made by the Bohemians to preserve their liberties and their distinctive language. But the Austrians, though frequently checked, gradually became stronger in their power over the country.

THE CRUSHING OF THE BOHEMIAN NATION AND THE SPLITTING UP OF POLAND

At last, in the Thirty Years War, even the victories of the Swedish king, Gustavus Adolphus, could not save them, and for long years the stifling, absolute rule of Austria became fixed and lasting, so that progress and the national feeling and language were crushed. But not hopelessly so. Bohemia took a brave share in the struggles for freedom that went on all over Europe during the last century, and many of the old hardships are now removed. There is religious liberty and self-government, and representation in the Imperial Parliament at Vienna, and freedom to revive Bohemian literature and art and the beloved mother-tongue.

Bohemia lies in the basin of the Elbe, which, like the Oder, drains to the north. By the "gates" forced by the rivers through the encircling ring of mountains, we pass to the province of Galicia. This, too, was settled in the far past by a Slav nation, the Poles. Constant and bewildering were the changes that came to them through the centuries. About the time that William of Normandy was conquering England, the Poles were forcing their way through the Carpathians and overrunning the great plains they enclose. Four hundred years later the King of Poland was chosen to be King of Bohemia. Then, when the Tudors were making

AN EMPRESS'S APPEAL TO THE NOBLES



For centuries the sovereigns of Austria looked upon the Hungarians with suspicion, and forbade them to possess arms lest they should rise in insurrection. But when the Austrian Empress, Maria Theresa, was attacked by enemies on all sides, and her throne was in danger, she took the bold step of appealing for help to the Hungarian nobles. Accompanied by her little son, she appeared before them, dressed in mourning and wearing the crown of St. Stephen, the first Christian king of Hungary, and her tears and eloquence moved the nobles to the wildest enthusiasm. Flashing their swords aloft, they declared that they and their sons would die for her.

themselves absolute in England, Poland was extending its borders in every direction, and securing reforms of many kinds. After that it lost its independence, regained it, lost it again, and suffered much. We see it flashing out in brave deeds, as in the relief of Vienna, when it drove away the Turks, and then comes the sad story—so deeply felt in Europe—of the sharing-out of this ancient and fine kingdom among stronger Powers. Austria's share lies chiefly in the province of Galicia.

THE MIXED RACES AND STATES THAT HAVE BEEN SLOWLY ABSORBED BY AUSTRIA

South of the Danube other Slav races settled as well as Teutons and Italians, and many states of mixed nationalities grew up and have been gradually absorbed by Austria. At Innsbruck, the capital of the Tyrol, is a bronze and marble memorial of the union of the Tyrol with Austria over 500 years ago. The famous tomb of the Emperor Maximilian is in the cathedral there, though he is buried elsewhere. But more interesting than all the reminders of Royalty in Innsbruck are the relics and monument of the patriot Hofer, who made such noble and determined efforts to defend his fatherland from the Austrian oppression. "It is time," he wrote on little bits of paper, and cast them to the hurrying streams to carry far and wide, and rouse the Tyrolese, ready and waiting to fly to arms at his call.

Salzburg is another famous Austrian town south of the Danube, full of the story of the past as regards the power of the Church. The town of Enns gives a link with English history in the times of the Crusades. Its walls were built with the money gathered with such difficulty to pay the ransom of Richard Cœur de Lion when he was taken prisoner on his way home through Austria.

THE ANCIENT KINGDOM OF HUNGARY AND ITS THOUSAND YEARS OF STRUGGLE

Of all the neighbours with whom Austria fought with varying success as the years rolled on, the most distinct and considerable were the Hungarians. A century after the East Mark was formed, a race of people from Asia, the Magyars, quite different from the Teutons in stock and speech, burst through a gap in the Carpathian Mountains, swarmed down the great valley of the river Tisza, the German Theiss, and on to the Danube, settling about its course where it makes a deep bend to the south. The kingdom of Hungary, which was thus founded, is larger than the united states of Austria. Its constitution is perhaps older than that of which the English are so proud, and the story of its relations with Austria is one of incessant struggle to preserve its ancient and free manner of government.

St. Stephen was Hungary's first Christian king, and under him the Hungarians became a settled and civilised nation about a thousand years ago. He is a national hero, whose example and deeds are still held up to reverent admiration.

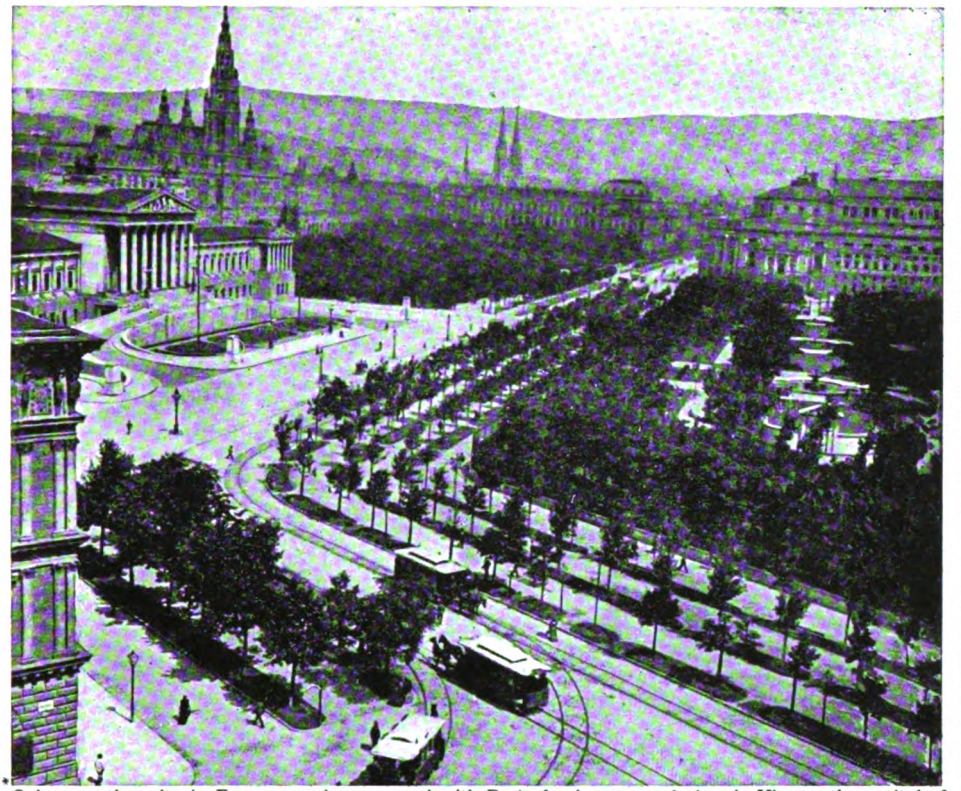
Hungary has been called the "bulwark and shield of Christendom," so often has it withstood the attacks of the Mohammedan Turks. The terror of these invaders along the old Danube highway hung over Europe for centuries, just as the terror of the Danes hung over England. There was a Turk's tax, as England had a Dane's tax, with which to organise resistance or pacify the invaders with bribes. Poland, Bohemia, Austria, as well as Hungary, had constantly to fight them, but Hungary, owing to its position, had to bear the brunt of their devastations.

THE FIRST PRINCE OF THE HOUSE OF HAPSBURG TO RULE OVER HUNGARY

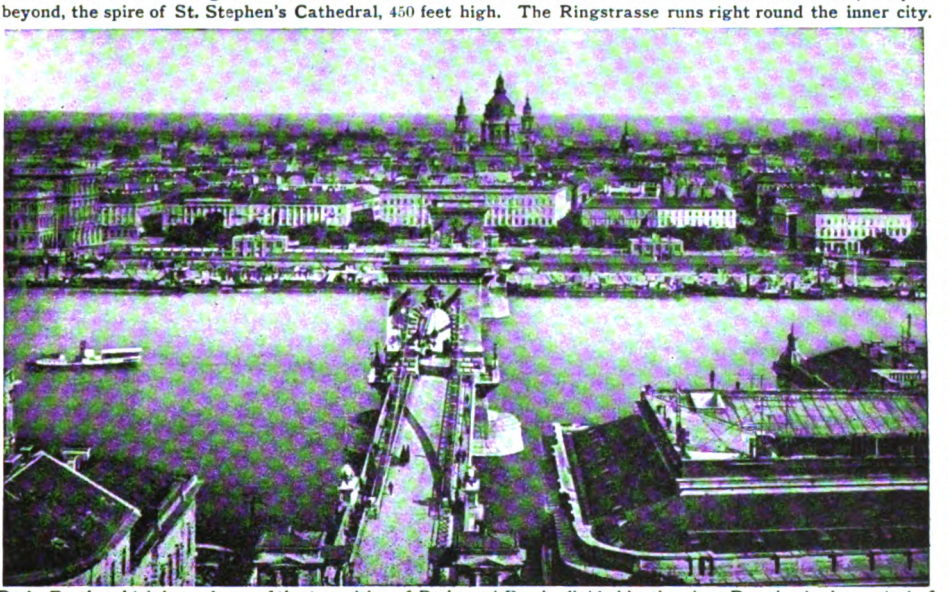
In the history of Hungary, full of progress, loss, alliance with neighbours, and bitter wars with them, there stand out many great rulers. One of them paid a visit to London after Henry V. gained his great victory of Agincourt, to try to make peace between England and France. This was Sigismund, who became King of Hungary, and was elected Holy Roman Emperor. It was a great honour, but left him little time to attend to driving back the Turks, who won, under a later king, the overwhelming victory of Mohacs. A desolate time followed, in which John Hunyadi fought bravely as the champion of Christianity against the Moslems.

A prince of the House of Hapsburg, when that family was at its greatest glory, was elected King of Hungary as well as of Bohemia. The Turks did not like this, and for long years the unhappy country was ruined by war; but Austrian rule was hard to shake off. For over 300 years there were oppressive taxes, risings of the people,

THE CAPITALS OF THE AUSTRIAN EMPIRE



Only one other city in Europe can be compared with Paris for beauty, and that is Vienna, the capital of Austria. Its Prater is the finest park in Europe, and the Ringstrasse, a part of which is shown in this picture, is said to be the most magnificent street in the world. On the left can be seen the Parliament House, and just beyond, the spire of St. Stephen's Cathedral, 450 feet high. The Ringstrasse runs right round the inner city.



Buda-Pesth, which is made up of the two cities of Buda and Pesth, divided by the river Danube, is the capital of Hungary and the most important commercial city of the Austrian Empire. The chain bridge shown in the picture, which is the finest of the three bridges that cross the river, was designed by an English engineer. The suburbs of the town are very beautiful.

and every effort made to destroy the nationality, the language, the free spirit of the Hungarians. Hope revived at times, and we see, on page 2853, how the Hungarian nobles responded to the appeal of Maria Theresa. There was a glimpse of freedom when Hungary was recognised as an independent nation, when the storm of the French Revolution was about to burst; but the privileges were lost again, and it needed long years of patriotic endeavour through the first half of last century to wrest back, bit by bit, the ancient rights so long trampled under foot by the Austrians.

HUNGARY SITS SIDE BY SIDE WITH AUSTRIA IN THE DUAL MONARCHY

During this time many Hungarian exiles went to England, among them the brave leader Kossuth. It was in June, 1868, that Francis Joseph, the Emperor of Austria, was crowned King of Hungary, with the ancient crown of St. Stephen, after promising to govern according to the old constitution of the country. And so it came to pass that the blood of the patriots was not shed in vain through the long years of struggle; for though often all liberty seemed lost, fresh effort ever gave new hope of success, and to-day Hungary sits side by side, co-equal in the great dual monarchy of the Danube.

"God save Francis the Emperor" are the opening words of the Austrian National Anthem, set to the beautiful tune to which we sing the hymn "Praise the Lord, ye Heavens adore Him." The strains greet the dignified, grey-haired old man belonging to the old line of Hapsburgs, who is both Emperor of Austria and King of Hungary, whenever he appears in public in Austria. He is the oldest sovereign in Europe, and his long, epoch-making reign began in the revolutionary times of 1848. He was still under forty when the Prussians rose to the leadership of the states after the Seven Days War.

THE BLENDING OF FRAGMENTS THAT MAKE UP THE UNITED EMPIRE

Napoleon III., who had such a very different experience after reverses, said that Francis Joseph was the only monarch in Europe who could return to his capital after defeat, disaster, and loss of territory, and yet be received with devotion and affectionate enthusiasm. Many are the stories of his kindness to little children and to the poor, and of his tact and good feeling in carrying out his share of the government of an empire of such varied nationalities. We must remember that there is no united Austrian nation, no common Austrian tongue; but that the empire consists of a leading German state, broken off from the rest of the German-speaking peoples when Prussia rose to be their head; of various states that are fragments of other nationalities, some still speaking their own languages, some more or less influenced by their German rulers. Besides these, there is the whole independent nationality of the Hungarians, of quite different origin from the Germans, with its own speech, manners, customs, and constitution.

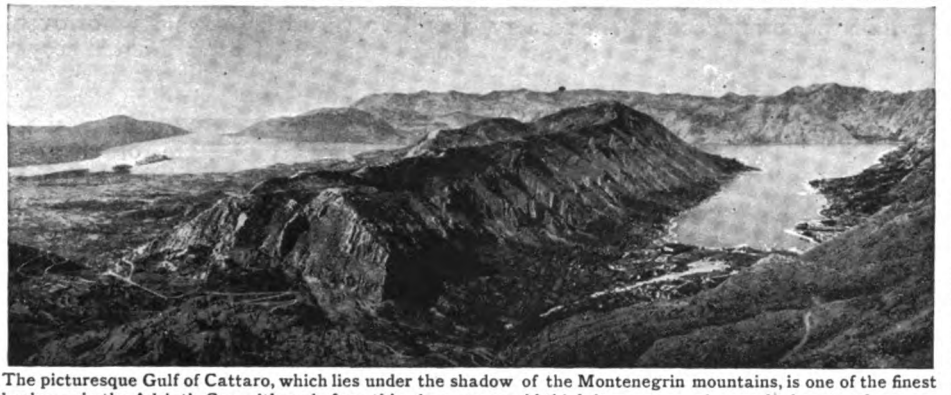
When people visit Austria and Hungary to-day it is generally the great wonder of the Danube that first claims their attention, as they make their way to Vienna, the capital of Austria, or to Buda-Pesth, the capital of Hungary, towards which all railway routes run.

WHERE THE THUNDER OF THE MIGHTY DANUBE CAN BE HEARD FOR MILES

One of the great features of the Danube are the "gates," or passes, where the mountain chains have been cut through by the ceaseless flow of the water. It is an impressive sight to watch the torrent dashing through deep and narrow rocky gorges, and then spreading out again in quiet beauty on the level plains beyond. At Passau, where the swelling Inn joins the main stream as it leaves Bavaria and enters Austria, is the Austrian Gate; the Hungarian Gate is just beyond Vienna, where the river enters Hungary. At the tremendous Iron Gate, where the rocks are 2,000 feet high, the thunderous roar of the mighty torrent can be heard for miles round. Leaving Hungary at this point, the river passes on its way to the sea between Roumania and Bulgaria.

These gates were important points of defence in the old days, and they greatly hindered long-distance traffic on the rivers. In the last century, however, immense trouble was taken, and canals were cut, often in the solid rock, so that ships can now pass in safety. Arrangements, too, are made to control and regulate the great flow of water,

AUSTRIAN CITIES AMONG THE MOUNTAINS



The picturesque Gulf of Cattaro, which lies under the shadow of the Montenegrin mountains, is one of the finest harbours in the Adriatic Sea, although, from this view, one would think it more conspicuous for beauty of scenery than for commercial usefulness. Great rocks divide the entrance into three separate channels, and two of these are so wide and deep that they will allow the passage of very large ships. The harbour is very strongly fortified.

Salzburg, which is almost on the borders of Bavaria, is best known as the birthplace of Mozart, the great musical composer. The oldest part of the quaint town is the citadel on the Monk's Hill, seen in this picture, which was originally built in the time of the Romans. Salzburg Cathedral is a miniature copy of St. Peter's at Rome.

Cattaro, although a little toy city with only 5,000 people, has two bishops, with a cathedral, twenty churches, and six convents. At one time it was the capital of a tiny republic. Being surrounded on three sides by the high mountains of Montenegro, Cattaro loses two hours of light every day, for the sun rises an hour later and sets an hour earlier than at other places in the same latitude. The little city has suffered much from earthquakes.

The photographs on these pages are by the Photocrome Co. and Underwood & Underwood, London.

especially when the ice comes crashing down on the spring floods. The scenery on the Danube is more varied than that of the Rhine, though in parts it is much like it, with castles and villages on the steep hills. Sometimes the high banks are covered with forests, and the river looks dark and grim; sometimes the blue of the heavens seems brought down to earth, as the broad waters hurry along across wide, smiling, fertile valleys, past islands covered with weeping willows. Occasionally the river divides into several streams, as in the rich plain of Vienna, so famous in history.

THE OLD CITY OF VIENNA AND THE BUSY TRAFFIC ON THE DANUBE

The old town lies unchanged, surrounded by a broad road lined with trees, called the Ringstrasse, beyond which buildings of every kind have grown up during the last century. In the old cathedral and churches, in the museums and picture galleries, are many reminders of the men and women famous in their country's story. In the vault of the Hapsburgs lies Marie Louise, who was made to marry Napoleon, and their son, forgotten by France, who died when about twenty. Festooned round the cannon in the courtyard of the arsenal is a chain of some 8,000 links, which the Turks threw across the Danube nearly 400 years ago to hinder the traffic.

The traffic on the Danube is very different now from what it was then. Rafts of wood still float down stream from the forests, and rough little flat-bottomed boats still paddle about from village to village. But, in addition, there are now regular lines of steamers for passengers and goods, steam tugs for the barges, and steam and electric launches for the rich folk who drive fine horses in the Ringstrasse, and have country estates in the Tyrol and the Adriatic lands, and other beautiful parts of the empire, as well as palaces in Vienna. There are over 2,000,000 people in Vienna, many of whom are engaged in various manufactures, and in building ships for the navigation of the Danube.

THE DIAMOND-SHAPED KINGDOM OF BOHEMIA, AND ITS ACTIVITIES

There are many railway routes into Bohemia and Moravia from Vienna, for both countries are rich in coal, and carry on many manufactures. In the little diamond-shaped kingdom of Bohemia, about two-thirds the size of Scotland, there is a very busy population of over 6,000,000 people. Many different crops are cultivated in the valleys, and work in mines and factories is carried on all over the country. Metal industries, such as the manufacture of engines and machinery, are carried on at Prague, the capital, also the making of cottons and woollens, sugar from beets, fine glass from the decaying granite of the mountains, and paper-making in the wooded hills. Moravia is a great woollen-manufacturing region. Between its capital, Brunn, and Vienna was fought Napoleon's famous battle of Austerlitz.

Silesia, part of which belongs to Austria, is easily reached by the river valleys that pierce the mountain wall and drain north. These "gates," through which trains run so easily now, night and day, to carry on the business north and south of the mountains, were formerly often the scenes of great battles when the pass was contested.

The Austrian lands north of the Carpathians are very cold in winter, and the plains, which in summer are green with cereals and potato crops, lie white and frozen through the long cold months.

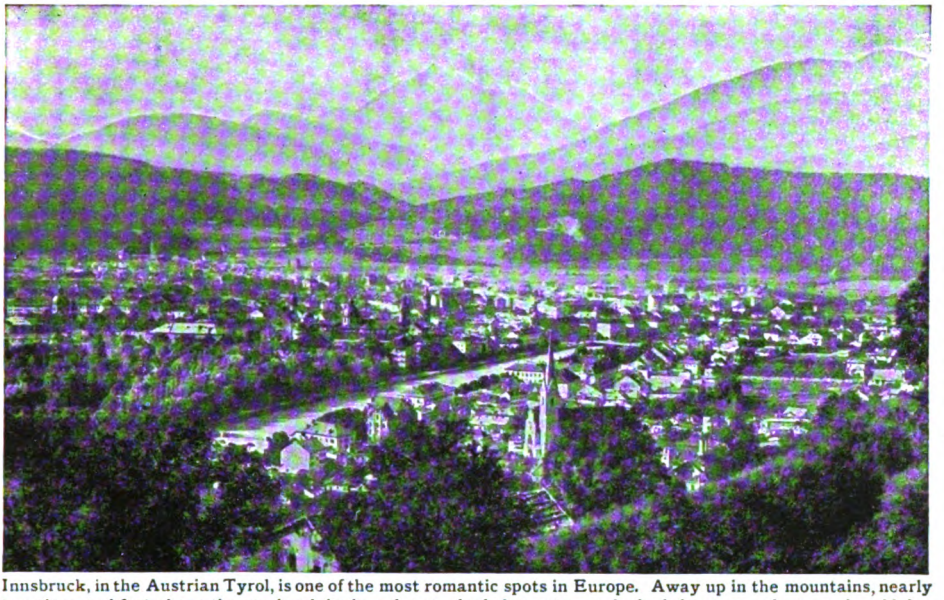
A CITY OF GLISTENING SALT THAT LIES 900 FEET BELOW THE GROUND

On the hillsides in these parts are dark patches of forests. Near Cracow, the old capital of Poland, is a whole town of mines 900 feet below the surface of the ground. It is two and a half miles long, three-quarters of a mile broad; all is glittering white, for it is formed of salt. These great beds of salt carry us back to ages long before history began, when this part of Europe was under the sea. When the water disappeared it left behind the salt it carried, and there it has remained stored in the bosom of Mother Earth.

What a contrast are these wind-swept plains and valleys of Galicia, the most northerly province of Austria, to those of the south, between the Danube and the Adriatic. There is snow and ice on the heights of the Tyrol, but the valleys are beautiful and sheltered, with picturesque castles on the slopes, and gay little streams and waterfalls making music everywhere. The lower plains are covered with rich crops and cattle.

As the deep blue of the Adriatic comes in sight between the slender stems of the palm-trees, the olive, the

THE BEAUTIFUL SCENERY OF THE TYROL



Innsbruck, in the Austrian Tyrol, is one of the most romantic spots in Europe. Away up in the mountains, nearly two thousand feet above the sea-level, its broad, tree-shaded streets are looked down upon by towering Alpine peaks, and lovers of the beautiful from all parts of the world visit Innsbruck and the Tyrol every summer.

The people of the Tyrol are among the most devoted patriots in the world. They have a passionate love for their beautiful country, and have fought bravely to preserve it from the oppressor. They are a simple-minded, devout people, and look very picturesque when seen working in the fields in their quaint national dress.

vine, the mulberry all flourish in the sunshine, and the roses in winter remind us of the Riviera and its balmy air. Trieste is the great commercial port of Austria, and Pola is the chief naval port and arsenal.

Along the coast strip of Dalmatia, so studded with islands, are many fine harbours, especially the large, beautiful harbour of Cattaro, where a whole fleet can ride at ease. But the mountains come down so close to the sea that the harbours are not of much use. The well-wooded mountains and fertile valleys of Bosnia and Herzegovina lie behind Dalmatia. Till lately these provinces belonged to Turkey, but were governed by Austria; now they are part of the Austrian Empire.

Between the Austrian ports of Istria and Dalmatia lies Fiume, the port of Hungary, in direct communication by rail with Buda-Pesth. This splendid double city—Buda on one side of the Danube, Pesth on the other—lies in the heart of Hungary, near the great southward bend of the river.

How the trains run out of one country into another

If we travel to it from Vienna by train, we find when at the Hungarian frontier, that the Austrian guards take down the German notices, and Hungarian officials replace them by Hungarian notices; the engineers are changed too, so completely do we pass from one country to another.

The numerous agricultural museums and colleges in Buda-Pesth, as well as the large flour-milling works, remind us of the chief source of wealth of Hungary—its wide plains of fertile soil. As we travel on the railways that cross these plains in every direction, or by the magnificent river routes, we can understand the saying that the plains of Hungary are a battlefield of human labour. The full waters of the Drave and the Save, which join the Danube on the south, and of the Tisza, which drains the grand circle of the Carpathians, are regulated and connected by canals, and used to water otherwise dry regions; and so we see fields of golden grain stretching to the horizon as in Canada. Hungarian flour is said to be the finest in the world. In other parts is fine pasturage, and we exclaim in wonder at the thousands of beautiful horses, the white cattle with wide-spreading horns, the herds of black buffaloes, roaming at will as far as eye can see.

The great plains are bounded on the north by the Carpathians. They are famed for their beautiful scenery, the highest mountains rising to about 9,000 feet, and for their hot springs, but above all for their great mineral wealth. Here are found coal, iron, copper, and other useful metals; also salt and gems.

An opal-mine worked for 1,000 years, and caverns like cathedrals

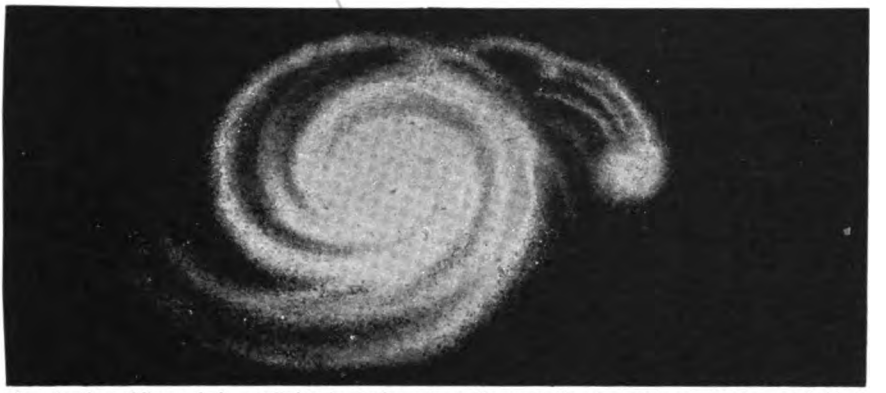
As we read of the wonder of underground Hungary, we think of the Arabian Nights, and all the fairy stories in which we have ever delighted. For besides an opal-mine which has been worked for a thousand years, and vast caverns with great cathedral-like pillars, and drapery in stone of every beautiful shape, there is a most extraordinary cavern of ice, discovered only a few years ago. As we draw near to its mouth, its icy breath is seen on the trees and bushes round as sparkling hoar-frost, even on the warmest days.

We step inside and the cold is Arctic and freezing indeed, and all round are solid blocks and walls of snowy ice in fantastic shapes. Just the haunt for fairies, we think, as we look at the two little butterflies imprisoned in a great block of clear ice near the entrance. Their merry dance was cut short—no one knows how long ago. Beautiful and wonderful as it all is, we are quite glad to return to warmth and life and the light of the sun. We see many different picturesque costumes in various parts of the country, and at the fairs and other gatherings of the people are many gipsies, playing their wild and interesting music. In the warmer parts of Hungary are many vineyards, from which fine wine is made.

The clear air that comes to Vienna from the snowy Alps

It looks a long way on the map from the Atlantic coast to Austria; but we can reach Vienna in about thirty hours, and Buda-Pesth in six more. As we steam along the plain of Vienna, we enjoy the clear, crisp air, fresh from the snowy Alps, the sunshine glancing over glowing orchards and farms and fragrant pine forests, and, above all, the dazzling blue of the rolling Danube.

The next story of Countries is on 2959.



Over half a million nebulæ, or light-clouds, have been discovered in the heavens, and at least half of these have a spiral form like the one seen here. As this great mass of glowing gas whirls round, we can see a part being thrown off, and some think this is the birth of a world like ours, with its moon.

THE MAKING OF OTHER WORLDS

CONTINUED FROM 2719

SCATTERED here and there among the stars we find cloudlike patches which are called nebulæ. The word nebula means a cloud. These nebulæ are of enormous size, occupying vastly more space than the biggest star. On the other hand, they are composed of matter which is in a very rarefied, or thin, condition, so that the mass of a nebula is very small compared with the enormous space it fills. Some idea of the size of nebulæ can be obtained from these words of Professor Newcomb: "A nebula only as large as our solar system would probably be invisible in the most powerful telescope, and could never be impressed even on the most delicate photograph of the sky unless above the ordinary brightness. Those that we know have probably hundreds or thousands of times the extent of our whole solar system."

It was not a great while ago that nebulæ were thought to be very few, for indeed, only a few were known. If they were really very few in number, it would be difficult for us to assign to them the great part we do in the evolution of the stars. But in recent years we have begun to learn that the number of nebulæ is really very great. At the beginning of the present century it was recognised that their number ran into tens of thousands, and six years ago it was stated that we were acquainted with 120,000 nebulæ. But the great telescope at the Lick Observatory in California has added largely to the number of nebulæ that we know, and we can positively state that the number of nebulæ is well over half a million. Doubtless, this is only a fraction of the number which will be known in fifty years or so, but it is very important for us to have, at any rate, some idea of the great number of the nebulæ, as the theory that they are stages in the history of stars evidently demands that their number should be great, as we now know it is.

And next we come to a very serious question. Suppose that there were a cluster of stars at a great distance from the earth, is it not probable that they would appear to us like a bright cloud of matter in the sky? The answer is that this would have to be so. Now, we know that there are such things as clusters of stars, and we can assign no limits to the distance of such clusters. May it not be, then, that what we call nebulæ are really nothing at all but star clusters seen at such a

distance that the individual stars cannot be distinguished from one another?

More than fifty years ago, Lord Rosse built a great telescope—the greatest then known—which was so powerful as to show that many appearances in the sky which had been called nebulæ were really groups of stars, their cloudy appearance being simply the result of their distance. Very naturally, astronomers were strongly inclined to believe that if only we had large enough telescopes all the nebulæ would be resolved into star clusters. Now, here is a case where it might have been thought that proof of what is really the truth could never be obtained. However large your telescope, you could never be certain that what looked like a nebula through it would not be seen as a star cluster through a still larger telescope.

But here again the marvellous spectroscope, about which we learnt on page 2716, comes to our aid. It has proved, beyond any question, that there are real nebulæ in the skies, consisting of gas and nothing else; that they are clouds of glowing gas, and not clusters of solid stars.

WHAT WE LEARN FROM THE LIGHT GIVEN OFF BY GLOWING GAS

The evidence really depends upon what we know about the kinds of spectra which we can study on the earth. We know that when we examine the light given out by a glowing gas, which is nothing but gas, it does not consist of a continuous band of colour, like the spectrum of sunlight, but of a larger or smaller number of bright lines with completely dark spaces between them. Thus we distinguish spectra as of two kinds, which are known as *continuous* and *discontinuous*. A continuous spectrum is a band of colour, and is produced by the light given off from anything which is not wholly a gas; a discontinuous spectrum consists of separate bright lines, and always means that the substance producing it is purely a gas. Now, it was discovered, especially by the English astronomer Sir William Huggins, that the spectra of many nebulæ are discontinuous, proving beyond question that they are really nebulæ, or clouds of gas, and nothing else. As we have already learnt, the theory that nebulæ have something to do with the making of suns or stars was first made entirely with reference to our own solar system. The idea first occurred, in his youth, to the great German thinker Kant, and it was afterwards worked out by a French mathematician called Laplace. He supposed that the solar system was made from a nebula shaped like a great globe, or sphere. He thought that this globe would in time become somewhat flattened as it spun, that rings would be detached from the outside of it and form planets.

THE SHAPE OF THE GREAT CLOUD FROM WHICH THE WORLD WAS MADE

This theory is not now maintained by anyone. Neither the solar system nor any of the systems of which other suns are the centres could be formed in this way. Rings would not be broken off in the fashion supposed, and if they were, they could not condense into planets. There are many other objections which, taken together, are quite fatal to this theory; not the least of them is that among all the nebulæ we have discovered there is not a single one which is really a ring, that would answer at all to Laplace's idea. Even the beautiful nebula in Lyra is known not to be a ring, but something else.

Laplace knew nothing whatever of any kind of nebula but a globular one, but we are in a very different position today. When Lord Rosse made his great telescope, he not only discovered with its aid that many so-called nebulæ are not really nebulæ, but he made the great discovery of what are called *spiral nebulæ*. We all know what a spiral staircase is, but we must not think of a spiral nebula as having that shape. It is a flat thing, unlike the staircase. On page 2861 we can see a photograph of a typical spiral nebula, which is, perhaps, more like a flaming "Catherine wheel" than anything else.

THE SILENT MOVING OF THE HEAVENS WHILE EMPIRES RISE AND FALL

This discovery was not at first believed; a Frenchman suggested that probably a spiral scratch had been made on one of the glasses of the telescope while cleaning it, and that this was all that Lord Rosse had seen. But we know now that spiral nebulæ are realities, and that they are very numerous. *At least one-half of all the nebulæ we know are spiral*, and the better photographs we take, the more do we find evidence of

spiral structure in nebulæ which had not previously been thought to be spiral.

Now, it is perfectly evident that this particular shape of so many nebulæ is not a matter of chance. All sorts of things are possible in the sky, and if we knew only one spiral nebula, or fifty or a hundred, we might put down this particular shape to the chance of perhaps some peculiar kind of collisions in the sky. But when we find that more than a half of all the nebulæ we know are spiral, it is quite evident that the spiral shape must represent a stage in the history of worlds.

When we study the photographs of some spiral nebulæ, we see appearances which suggest that suns or stars are being formed in them, as if the matter composing the nebula were condensing in places. There can be little doubt that such nebulæ as these are indeed forming star clusters, similar to those which we see in other parts of the sky, and those star clusters represent later stages in the history of spiral nebulæ. In the case of a system like ours, where there is only one star and not a cluster, we must suppose that the original nebula was a very much simpler and smaller thing than the spiral nebulæ we see in the sky. How many millions of comparatively small nebulæ there may be in the sky—too faint for us to see or even to photograph—no one can say. It is probable that those we see are only the giant specimens which are going to make star clusters, and not the little ones which are going to make individual stars like our sun.

This is the nebula in the southern constellation of Argo, or the Ship, and it is supposed that in the beginning, our solar system was in this form of a vast volume of gas.

In the study of the spiral nebulæ the spectroscope again comes to our aid. It has been said that they look as if they were turning solid in parts—as if here and there stars were being formed out of the gaseous matter. The evidence of the spectroscope confirms this view, for it shows that the spectra of spiral nebulæ are not wholly discontinuous, but are just such as we should expect from a mixture of partly gaseous and partly solidifying matter.

If a spiral nebula is to condense into stars, or if a very tiny spiral nebula, such as we cannot see, is to condense down into something like the solar system, we must suppose that the nebula is spinning. It would be very satisfactory if we could watch a spiral nebula, and see it spin before our eyes. This cannot be, however. We must remember that we are looking at objects so large that to add our solar system to them over and over again would make no apparent difference. We see no spinning. Nevertheless, there is every reason to suppose that these nebulæ are spinning. It is our business to record as accurately and in as much detail as possible what we see, and so begin to provide the evidence which will enable future generations of astronomers to prove that these nebulæ are spinning. If we suppose that they are spinning, it is natural and easy to understand how separate stars or planets may be formed by being detached from the spiral branches of the nebula, and there are not a few photographs of nebulæ in which we seem to see this happening, though it is impossible to get proof in lives so short as ours. One of the best authorities says:

"The heavens show us thousands of spiral nebulæ which are evidently in a state of rotation round a central nucleus, but which will probably take ages before they have finally consolidated into suns and solar systems. But ages are but moments in the evolution of the stars, and we need not expect to find much evidence of rotation and consolidation

during the brief span of human history. Empires rise and fall, dynasties are founded and dissolved, but the heavens move on in their silent course, and the human race will probably have perished before the universe has reached its final destiny."

But I do not know that we have any right to use such words as "final destiny." It may be that there is no end to the drama of Nature. At any rate, we are beginning to find evidence that there may be new beginnings, even when the end seems to have come.

THE CHANGES THAT MAY GO ON FROM AGE TO AGE IN THE SKIES

When we were studying the stars, we traced their history through various stages of brightness until at last they became dark, cold, "dead suns." That seems to be an end, and it might be supposed that all the stars are running towards this end, so that one day there will be a universe of nothing but dead suns. But, on the other hand, we see in the heavens examples of all the earlier stages in star history, including even these hundreds of thousands of nebulæ.

There are, then, new beginnings being made, and the question is, How? Can we suppose that anything could happen to a cold, dark star which could transform it into a nebula? If this can be supposed, then our theory of star evolution begins to be complete, for instead of having a process running along a line, we shall see that there is a process running in a circle, and we may suppose that this circle, or cycle, represents what happens from age to age in the skies, and that the different kinds of object we see represent different stages of it in different cases.

DO WORLDS BEGIN IN GREAT COLLISIONS IN THE SKY?

The stars, we know, both bright and dark, are not fixed, but moving. We have clear proof also that gravitation is at work among the stars. If, then, they all have an attraction for one another according to their mass and distance from each other, and if these distances are constantly changing as they move, there is the possibility of collision.

It is more than possible; it is exceedingly probable. If a dark star and a bright one, or two dark stars, ran into one another, or merely grazed each other, what should we expect to happen? Their motion would be largely transformed by friction into heat, just as when you rub your hands together. If this heat were intense enough, it would convert all the matter of the stars into a gaseous form again; in other words, such a collision might *create a nebula*. It is natural to ask whether we have ever seen such a thing happen. It may be that we have, or, at any rate, that some of the cases where new stars have blazed out suddenly are due to some kind of collision in the sky.

Recently various astronomers have shown that if two dark stars grazed each other, or even approached closely to each other, without actually touching, there would be not only the production of great heat, but also tidal effects. These tides, it is believed, would cause explosions and eruptions of gaseous matter, and it can be proved that the matter ejected would take the spiral form. In theory, we should expect to find that in such a case there would be two spiral branches produced at directly opposite points, like tides upon the earth.

THE WONDER OF THE LIFE-HISTORY OF A STAR IN THE HEAVENS

Now, it is very remarkable that when we study the spiral nebulæ we find that they usually do have two spirals, and that in almost every case these come out from the central nucleus of the nebula at points directly opposite to each other.

Here, then, is further evidence that celestial collisions may be responsible for the creation of nebulæ from stars that have run their course. These immensely interesting ideas are comparatively quite new, and we are only at the beginning of the study of them. There is no doubt that a great part of the astronomy of the future will be devoted to the study of the spiral nebulæ.

There are many nebulæ which do not seem to be spiral at all, and many in which only traces of a spiral structure can be detected. It may very well be that nebulæ which have no spiral structure are sometimes formed by actual headlong collision between stars, dark or bright; and it is important to inquire whether such nebulæ in the course of time would tend to take a spiral form. We believe that they would. Given a shapeless nebula in which movement was going on, however irregular, it seems to be certain that in the course

A MIGHTY CLOUD OF GLOWING GAS

This is one of the most wonderful photographs ever taken. It shows the great nebula that can be seen, even with the naked eye, in the constellation of Orion. The nebula is a great cloud of glowing gas, more than a million times as big as the earth's orbit round the sun, and was first discovered in 1659. But it was not until 1880 that it was first photographed, in America. The splendid photograph on this page was taken at the famous Lick Observatory, in California, by the late Professor J. E. Keeler, one of the greatest authorities on nebulæ, and shows the nebula as it appears to astronomers through the best telescopes. By means of such photographs future generations will be able to see whether the nebulæ change at all in the course of centuries.

of time such a body would slowly begin to assume a spiral form. On the other hand, a nebula might be spiral from the first if made as a consequence of a "grazing collision."

A NEBULA GREATER THAN MANY MILLIONS OF EARTHS

It is probable that there are dark nebulæ. It may be that a dark nebula as it shrinks gets warm and bright; that the next stage is the taking of a spiral form; then the formation of star systems or of solar systems, such as ours; and so through various stages of brightness and temperature to darkness. In the course of this long history there is probably a stage of rise in temperature, and then a stage of fall in temperature. There seems to be no doubt that our sun is in the second of these two stages.

We ought to know where to find the finest of the nebulæ. When we were describing the principal constellations, we learnt about the great nebula in Orion, which was discovered just 250 years ago. We find that photographs of this amazing object show us six large stars lying in a nebula, which scatters away into space to a stupendous distance around them. When we look farther we find that these six stars are only a small number of the whole, though we do not know how many of the hundreds of stars which can be seen here are really part of the nebula. We have real evidence in this particular case that slow changes are going on. Some idea of the size of the great nebula may be obtained from the comparison made by Sir Robert Ball. If we could imagine a great globe bounded by the earth's path round the sun, it is certain that a million such globes could be easily engulfed in the great Orion nebula. It contains an enormous quantity of hydrogen.

THE ETHER THAT IS EVERYWHERE, AND THAT NO MAN UNDERSTANDS

We ought also to know the great nebula in the constellation Andromeda, which is not far from Cassiopeia. This splendid object is really a true spiral. So, also, is the so-called "ring nebula" in Lyra. The nebula in the southern constellation, Argo, is not spiral. Here we must end our brief study of astronomy, the oldest and most magnificent of all the sciences. We are really only at the beginning of the "new astronomy" created by the spectroscope, and no science has a greater future before it.

But a word or two must be said in conclusion regarding the greatest and most urgent of the problems which the astronomy of the future has to solve. This centres round the word "ether." The ether is certainly something as real as this paper, though it is not ordinary matter, but very different, and is believed to be absolutely everywhere. The vast "empty" spaces between the stars are all completely filled with it. It is the medium which conveys their light from one to another across billions of miles, just as it conveys the light a few inches from this page to our eyes. It is here, where the air is, and it fills the spaces between the heavenly bodies, where there is no air. It is the medium by and through which universal gravitation exerts its power.

THE RIDDLE OF THE ETHER THAT MEN EVERYWHERE ARE TRYING TO ANSWER

More than this, we now believe that what we call ordinary matter, of which our bodies, earth and sun, stars, nebulæ, and comet are composed, is really a product of the ether; and probably that after an atom has run its course, whether here or a billion miles away, it is resolved again into the infinite ocean of ether, like a melting iceberg in the sea from which it was made. As yet we know very little about the ether, and even less about the relations that exist between it and ordinary matter. We do not know whether the earth or any heavenly bodies in their movement are at all retarded by the ether, though, if they are so retarded, the influence of the ether is too slight for us to detect.

All over the world astronomers, and not only astronomers, but also students of light and electricity and chemistry, are working at the riddle of the ether, for it comes into every scientific question, and is the unanswered problem at the bottom of everything. Yet there is reason to hope that the problem is not insoluble, and its solution will be the deepest scientific discovery of all time.

We shall next have to return to more homely matters, and learn the chief facts of geology, the science which deals with the history of the surface of the one heavenly body which we can study at close quarters—our own earth.

The next part of this is on page 2881.

A VIOLIN FROM A CIGAR-BOX

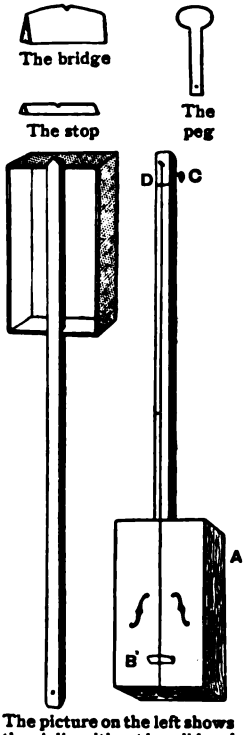
CONTINUED FROM 2772

THE easiest musical instrument to play is the one-stringed violin. If we have what is called "a good ear" for music, if, in fact, we can hum, sing, or whistle an air correctly after having heard it once or twice, we shall soon be able to play a one-stringed violin. We need not study music. We need not even be able to read the notes. We shall simply learn by experience where to put our finger on the string of the violin to get any note we require, and in a very short time, perhaps in a day or two, we shall be able to play simple tunes.

Occasionally these instruments are to be seen in music shops, but it is so easy to make one that it is really hardly worth while to spend money. We shall make our violin out of a cigar-box. The right size is a box made to hold fifty cigars.

First we must take off all the paper that is stuck round the edges of the box. The easiest way to do this is to scrub it off with a hard nail-brush that has been dipped into boiling water. We must not make the wood wetter than we can help, or it will warp. The lid will now come right off, because it was only the paper that formed the hinge. On this lid we must draw with a pencil the two little figures, something like an **S** in shape, that are shown in the illustration. We can cut these shapes out with a fret-saw in a few minutes. Let us do it as neatly as we can, for the appearance of our violin depends upon this part being done well.

Now we must get a piece of hard wood about thirty inches long. Walnut or mahogany will do. It should be about three-quarters of an inch wide and half an inch thick. A carpenter will cut a piece to these measurements for a quarter We should ask him to plane away the sharp edges on one side and leave the others square. Then, when we look at the end of the wood, we shall see that it is shaped like a **D**; round on one side and flat on the other. Now with a sharp penknife we must cut two notches in the ends of the cigar-box for this piece of wood to fit into. When we have made the notches almost big enough with the knife, we should wrap a piece of sand-paper round the wood that is to fit into them and rub it steadily backwards and forwards in the notches until they are quite smooth. In this way we can fit the wood into them very neatly.



The picture on the left shows the violin without box-lid and that on the right the complete violin. (A) Cigar-box; (B) bridge; (C) peg; (D) stop

Now glue the wood into the notches, leaving about one inch projecting at one end. Then put a little glue all round the edges of the box and on the wood between the two sides, and fix the lid into its place again. A few tiny brass screws put in carefully round the edge of the lid will make it all quite firm.

Now, about one inch from the end of the long piece of wood, make a hole about one-third of an inch in diameter, and fit into it a small wooden peg shaped like the one shown in the picture.

Your violin is now practically complete. We need only two tiny pieces of some hard wood. One will form what is called the bridge, and the other will be merely a thin strip which is glued close to the peg and is called the "stop." We can cut them out of a boxwood ruler that costs a nickle. The picture shows how they are to be fixed.

Now we must go to a music shop and ask for one "A" string for a violin. This will cost ten cents. "A" strings are generally made double the length required for ordinary violins, so they will be just right for ours. We had better tell the shop

people that we want a double-length one, uncut, and they will understand. At the same time we can buy a violin bow. New ones can be bought for a dollar, but often music stores have second-hand ones that will be sold for much less, and these are sometimes better than those that have never been used before.

Before we attempt to fix the string we must cut the little piece of wood that projects from the bottom of the violin to a point. Then we must make the box quite smooth with sandpaper and give it a coat of varnish.

When the varnish is quite hard, take the string and make a loop at one end large enough to slip over the projecting point. Then stretch the string to the other end, make a small hole through the peg, and thread the string through it. Now put the "bridge" into its proper place, as shown in the drawing, and make the string tight by turning the peg. When it is tight, draw the bow across it gently, and if it gives out a clear note, our violin is a success.

Now we shall find that we can amuse ourselves for hours trying to play on it, and we shall be surprised to find how quickly we shall learn to slide our finger up and down the string so as to get the notes we want.

In a very few hours we shall have learned to play something, and then we shall improve every day. Probably we should never learn to play an ordinary violin by ourselves; that is why people say it is such a "difficult" instrument. But this kind which has only one string is the easiest instrument to play that has ever been invented.

But, although it is easy to learn, we must not think that it does not sound well. When we have practised for some time we shall be delighted with it. Then we can get somebody to accompany us on the piano, and we shall improve rapidly till we have become quite good violinists.

These one-stringed instruments are often played at public concerts, and some performers are quite well known. Most of them play on cigar-box violins that they have made themselves in the manner here described. It must be explained that this instrument is not held like an ordinary violin. The box part is placed between the knees, the string is fingered with the left hand, and the bow is, of course, held in the fingers of the right hand.

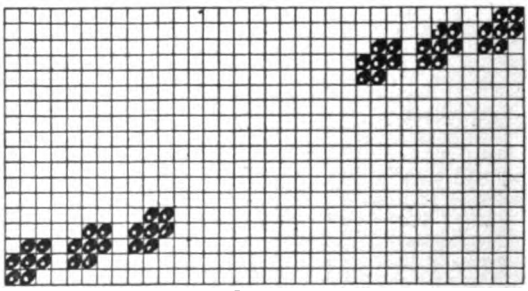
A BEAD BELT THAT ANY GIRL CAN MAKE

THERE are three ways of making a bead belt. We can string the beads together somewhat after the method shown on page 2033, without attaching them to any material; we can make the belt on a loom, which sounds very difficult, but is really a good way and very interesting to do; a third way is to sew the beads on to canvas. As the last of these three is quite easy, we are going to follow that way first, and later on find out not only how to use the bead loom, but how to make one for ourselves.

Now for the materials. We shall need a strip of fine canvas, which may be cut from 1½ inches to 2 inches wide, according to the width of belt desired. The length of the strip must, of course, depend on the measurement of the waist.

But as we are going to make a particular belt, we decide that it shall measure 21 inches in length and 1¼ inches in width. As to the material, Penelope canvas, No. 50, 27 inches wide, is suitable, and a quarter of a yard would make several belts. A fine cream-coloured French canvas is also used for bead-work. We shall need a spool of white linen thread, or, better still, some white dental floss. The floss looks better and wears well, provided the beads are good ones and do not cut it. Waxing the thread or floss a little prevents injury. It would never do to have the thread break and the beads drop off the belt. The choice of beads depends much on the pattern to be worked. The opaque Tosca beads would suit our design. They must be evenly formed and of a size to fit the hole or mesh in the canvas. The price is only a few cents a package, and we shall need about six packages of pale blue, one of white, and a few amber crystal beads.

We can buy bead needles by the packet, and we had better try one through the canvas and a bead to see that it is the right size. No. 12 will probably fit. The pretty design which we have chosen for our belt has three white daisies in a row, at intervals of 1 inch between the rows, placed along the edges of the belt, as shown in picture 1. The daisies will go with any shade, therefore the colour of the background can match that of the dress with which the belt is to be worn. We will make it pale blue. It is well to cut the canvas about 24 meshes wide, so that three meshes are left for turnings at each edge, and the eighteen meshes between filled with beads. The ends of the canvas must also be cut to allow for turnings; so we make the strip a little longer than 21 inches.

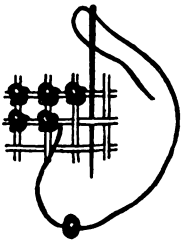


1. The pattern

The beads are sewn on to the canvas where the bars cross, and they always lie crosswise on the canvas, or diagonally. We secure the knotted end of the thread or floss

on the wrong side of the canvas, beginning at the left bottom corner of one end. To sew on a bead we thread one, pass the needle down into a mesh, pass it behind and under the cross-bar below and bring it through the mesh, as shown in picture 2. Beads are thus sewn on till the end of the row is reached.

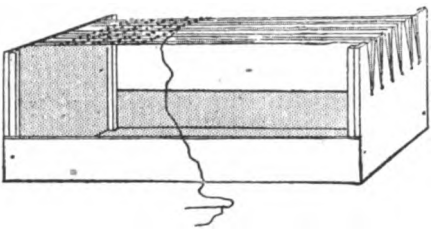
As all the beads must slant in the same direction, when we reach the opposite end of the belt we can either turn the canvas upside down and proceed with the next row of beads, which is the simpler way, or we can run the needle along the back of the canvas, and sew the next row of beads under the last one.



2. Sewing on the beads

We must look carefully at the pattern to find out where to sew the six white beads for the daisy petals and the amber ones for the centres. To avoid possibility of error, it is well to mark with a pencil the position of the daisies on the canvas, so that we shall know where to replace the blue beads with the white and amber ones.

When the beads cover the canvas, we stitch down the turnings and line the belt with sateen to match the blue groundwork beads. Then clasps can be sewn on to the ends. Pretty ones may be had for a very trifling sum.

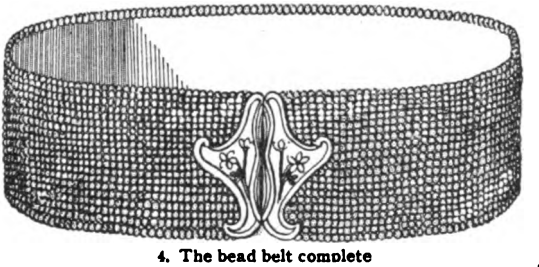


3. The bead loom

Small bead-work articles can be made by threading the beads together like a network without using any material for a support, and keeping two needles and threads in use while threading them. The work is then backed to give it a support.

This method is not advisable where a large surface is to be covered. It is somewhat like that of the loom-work now to be described.

A bead loom is not a large machine, but a small and most useful contrivance for making many bead articles. It has long found favour in America, and is getting very well known. We can buy one at a fancy-needlework store in almost all our cities—or we can make one for ourselves out of an oblong wooden cigar-box in the way shown in picture 3. First we take off the lid. Then we cut down the two sides by ruling a line along them one inch from the bottom. After passing a sharp knife several times along the line, the wood will snap off, and the rough edges can be smoothed with sandpaper.



4. The bead belt complete

The small strips of wood half an inch square seen from the ends, to match the height of the box, are nailed inside the corners to strengthen the ends. Along the tops of the end pieces we cut little notches one-sixteenth of an inch apart. These are to hold the warp threads, which are stretched across the open box and fastened round six little screw-eyes below in the end pieces of the box.

This home-made bead loom will be found useful for all kinds of purposes. A simpler one still can be made by nailing two upright pieces of wood on to a bar, or even by nailing two pieces of perforated cardboard to the wooden frame of a child's slate.

The woof threads should be just two-thirds as coarse as the warp ones. For instance, a warp thread No. 60 would have a woof thread No. 90. A bead needle, size No. 11, and loom beads, about No. 4-0, will be needed.

To make our belt, which, it will be remembered, is eighteen beads wide, we fasten to the loom twenty warp threads about 26 inches long. The two outer ones are to form the edges of the belt.

First we take a needleful of white linen thread and tie it to the left top warp thread, and then thread eighteen beads on to it, according to the pattern.

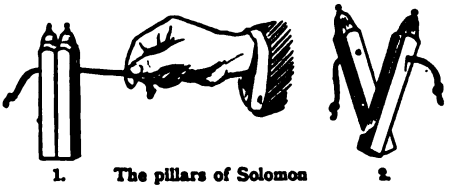
Now comes the important thing in bead loom-work. We carry the needle with the string of beads *under* the warp thread, so that when the fingers press the beads upward from underneath, they come up through the spaces between the warp threads. To keep them in place we pass the needle through the beads from right to left *over* the warp threads this time. The row of beads is now secure. We proceed with the other rows, picking up the blue, white, or amber beads according to pattern. The woof thread is fastened off by passing it through two or three rows of beads. Having made the belt the desired length, we gather the warp threads into four bundles of five each and tie these up close to the beads. They can be stitched on to a piece of silk or other material, and clasps attached to the two ends of this. The daisies will look best done on bead-work done with the loom, because the beads are placed perpendicularly in threading them, not diagonally, as they are in canvas-work.

Neat little serviette rings are made with canvas bead-work.

Many of the designs of the American Indian women are both quaint and beautiful, and their pretty patterns are worth imitating.

THE PILLARS OF SOLOMON

If the young reader has the good fortune to possess a box of conjuring tricks, we may be pretty sure that one of the items is that known by the imposing title of "The Pillars of Solomon." This consists of two square pieces of mahogany, four inches long, laid side by side as shown in our first picture, with a piece of string running backwards and forwards through a hole near one end of each. There is a knot at each end of the string, and when the cord on either side is pulled, that on the opposite side shortens accordingly. So far, there is nothing surprising. But presently the exhibitor of the trick passes the blade of a knife between the two "pillars." To all appearance the string is thereby cut in halves, and he proves that it is so by moving the pillars slightly apart as in the second picture, and showing the cut ends. And yet, when he brings the pillars back to their original position, one against the other, the string has somehow become one again, and can be pulled backwards and forwards as freely as ever it was before it was apparently cut.



1. The pillars of Solomon 2.

There is, however, a weak point. The two pillars are pivoted together at the bottom, so that they cannot be separated, and a sharp looker-on soon guesses the secret, which is that the string, instead of passing straight through from side to side as it appears to do, goes down the one pillar and up the other. The supposed cut ends, as shown in the second picture, are mere make-believes, short bits of string artfully glued into the wood.

If the reader has ever been in the East, and visited India, he may have seen the same trick performed by the Indian conjurers, but in a much more surprising way. The "pillars" are in this case two sticks of bamboo. There is here no pretence of cutting the string, but after the conjurer has pulled it backwards and forwards two or three times with the sticks held side by side, he does the same thing with their outer ends held some inches apart. But the sticks are still held together at the bottom, and some clever person is pretty sure to say to his friends, "I know how that's done! The string goes from the one stick to the other at the bottom; you will see that he can't separate them." And he looks round at the company with a superior smile. But the conjurer smiles too, and holds the sticks wide apart, one in each hand. And yet, when he puts them together again, the string is drawn backwards and forwards, as before.

3. An improvement on the pillars of Solomon

Now, this is really an excellent trick, and it has the additional recommendation that the young conjurer can easily manufacture the needful apparatus for himself. For the "pillars" he must get a couple of straight pieces of elder, about seven or eight inches long and three-quarters of an inch thick. From these he must push out the pith, as if he were going to make pop-guns of them. He must then, with a stout brad-awl, make a little hole through one side of each, about an inch away from what we will call the upper end. Through each of these holes he must pass a thin cord, and, with the help of a piece of wire bent into a hook, draw it down the stick and out at the opposite end. A tiny weight must now be attached to this end of the cord. An easy way to do this is to roll a bit of tinfoil into a hard ball, about half an inch in diameter, make a hole through it, pass the cord through the hole, and make a knot on the under side. A little bit of brass tubing, or a bullet with a hole through it, as sometimes used by fishermen, may be used instead of the tinfoil ball, if more easily obtainable, the test of all being, as it should be, that, if you hold the stick upright, draw the cord up as far as it will go, and then release it, the weight will draw it gently down again.

Having thus weighted one end of the string, you must draw up the opposite end as far as it will go, cut off all but six inches of it, and make another knot on the free end.

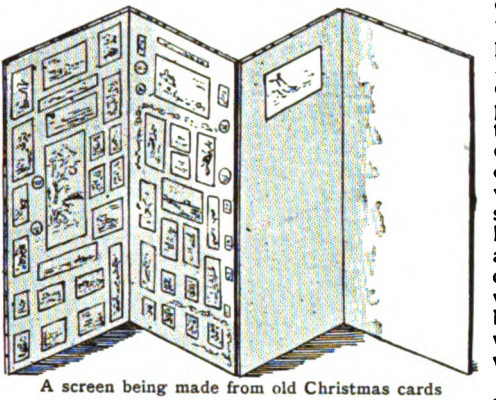
There is no real necessity to close the ends of the stick, but you may improve their appearance by pressing a cork into each and finishing off with a little red sealing-wax.

To show the trick, hold the two sticks horizontally in the left hand, as shown in our third picture. The cord in the stick to the left must be drawn out to its fullest extent, but the weight in the other stick must have been previously allowed to run down to the bottom, drawing down the cord and leaving only the upper knot visible. Now slowly pull out the cord on the right, at the same time slightly elevating the upper ends of the two sticks, when the cord in the opposite stick will naturally be shortened, the little weight drawing it down inside. Lower the sticks again to the horizontal position, pass them into the opposite hand, and proceed as before, pulling the left-hand cord and letting the right-hand cord retire into the stick.

This is the whole of the secret. To cause either cord to shorten, you have merely to tilt the stick so as to make the little weight within it run down into the stick. To lengthen the other cord, you must draw it out with the fingers. But the two movements must be made simultaneously, and it is in the neatness with which they are combined that the magic of the feat consists

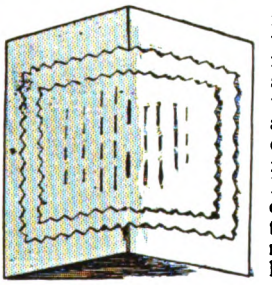
NEW USES FOR OLD CHRISTMAS CARDS

AFTER Christmas and New Year's Day everyone has a collection of cards. Often these are put away in a drawer or box, and no one sees any more of them. But it is a pity not to make some use of the pictures which the postman brings to our houses. What can we do with them? Here is one suggestion. Suppose we get some long pieces of wood and nail them together to make the frame for a screen. Or a wooden frame can be bought ready made in the form of a clothes-horse for a trifling sum. If a carpenter is near, he would nail up a frame for us quite cheaply and hinge it at the folds. A small three-folding screen would hold all our choicest cards, and it would certainly be both useful and decorative. Then think how sick children in hospitals would like to have such a pretty thing to look at!



A screen being made from old Christmas cards

The most suitable material for covering the frame is black shiny linenette, which can be purchased forty-two inches wide. The quantity needed will depend on the size of the screen. It should be wide enough to cover the fold of the screen, so that we do not have to cut it and make a seam, which will bulge and cause unevenness of the surface. With tin-tacks we nail the linenette on to the framework, taking care not to split the wood. Now the screen is ready for the cards, and we can see the advantage of covering it with black. The cards are bright coloured and the black makes a suitable background for them, and does not clash with any colour.

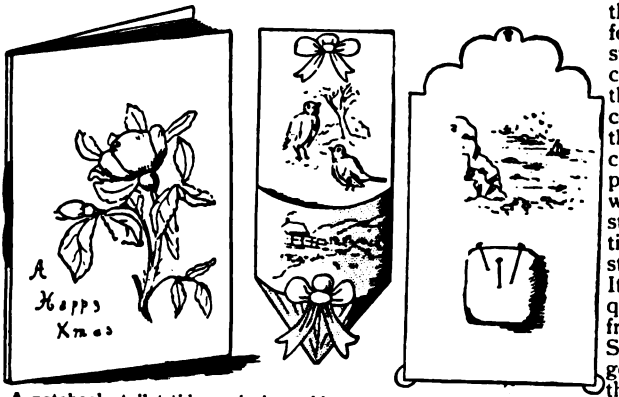


A needle-case

The Christmas and New Year cards must be carefully chosen from the heaps accumulated during several years. Many are in booklet form, and either the outsides or the insides are alone suitable. Some have writing below the picture, others are commonplace. Some are not pretty enough to go on our screen, although, of course, we should not like to hurt our friends by saying so. So we choose the best of them, such as a little invalid child, or sick man or woman, will take pleasure in looking at. If we have not sufficient cards, picture postcards will come to our aid, and it is quite possible that in our hunt for nice ones we may come across some coloured prints, larger than the cards, and suitable for a central picture round which the cards can be arranged. Scissors will have to be at work now.

The whole beauty of the finished screen will depend on the taste we show in arranging the cards, and we have to think, too, that both sides of the screen are to be covered; therefore, it is well to have some method in the arrangement. It would not be a bad idea to place flowers on one fold of the screen, animals on another, country views on another, children on another, and so on. Again, the cards might be grouped according to place, say, the American, English, Canadian, etc. Of course, it is possible to group them according to date when received, but then artistic effect has to be sacrificed.

As the screen will need to be varnished, it is better to gum the cards on to it, taking care to use a good stickfast gum. If we use paste we should make it from starch, and the best way to do this is to put a few pieces of starch into a cup and dissolve them in a little cold water. Stir this to a thick cream, then pour in boiling water, carefully stirring all the time until the starch stiffens. It should be quite clear and free from lumps. Set it aside to get cool, and then it will be ready for use. When the cards are all stuck on the screen and have had time to dry, we varnish the whole surface, using a brush for the purpose and applying the varnish evenly and smoothly, as shown in



A notebook, toilet-tidy, and pin-cushion made from old Christmas or New Year cards

the directions for varnishing on page 2256. We have used plenty of single cards and picture postcards for the screen, and doubtless have many double or triple folding cards still in hand. Suppose we use two or three of these for the covers of little notebooks. We can cut and fold the paper for the leaves, and stitch these into the cover at the back, using a strong needle and thread and fastening it in the same way as in an exercise book.

An address book is always a useful thing to have at hand. This can be made from a folding card in the same way, but instead of leaving the right edges of the pages as they are, we cut a strip out of the first page, just leaving a piece at the top where A is to be written. Two or three pages on we leave a little longer strip and write B on it, so that when the book is closed B shows just below A. We leave most pages for A, B, C, L, M, P, S, T, and one each only for such letters as G, I, V. In entering the addresses of our friends, the surname stands first.

Then we may have a very pretty calendar left from last year with all the dates torn off. Its picture is a familiar friend and we do not like to throw it away, yet there it is, used up as far as the dates go. Suppose we make a little pad of cotton-wool and cover it with silk, and stick this with glue or strong gum where the dates have been. Then we still have our calendar picture before us, and a useful pin-cushion as well.

A needle-case can be made from a folding card. We can cover it with a piece of net to protect the card from wear, line it with an odd piece of silk, cut two or three pieces of thin flannel to make the pages of the needle-case, notching these round the edges and tying them to the back with a piece of baby-ribbon, and there is our needle-case book complete.

Clever fingers can also contrive a little stamp-box out of Christmas cards or parts of them. But many similar ideas are likely to suggest themselves to those who like to see things put to good use.

A girl can make a useful toilet-tidy for her dressing-table, using some of the long-shaped cards for the purpose, piercing holes in these with a stiletto and threading the bent card on to the upright one with narrow ribbon. It can be finished off with bows and lined with writing-paper so as to look quite neat.

ANSWERS TO THE GAME OF "WHAT-IS-ITS-NAME?"

ON page 2772 are some descriptions of animals, and we have to guess their names from the descriptions that are given. These are the names of the different creatures:

1. Spider. 3. Giraffe. 5. Bat.
2. Tortoise. 4. Amœba. 6. Porpoise.

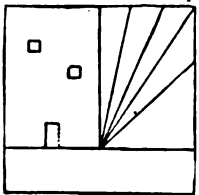
THE SOLUTION TO THE PUZZLE OF THE SECRET LOCK

WE read on page 2766 how a rich man, who wished to preserve his valuable vessels safely, made a safe and fastened it securely with a lock which would only open when three pointers on three dials pointed to three different letters which formed an English word. Knowing this, we thought that it might be possible to find out the word, and this is the way the word can be thought out.

Every English word must have at least one vowel, or otherwise we could not pronounce it. When we look at the dials we find that the only vowel that appears on them is the letter Y, and therefore we know that this letter comes into our word. No English word begins with a Y and has the two following letters consonants. Also, all the words of three letters which begin with two consonants either begin with an S or have H, L, or R as their second letter. But these four consonants do not appear on the dials. Therefore, Y must be the middle letter of our word, and going very carefully through the consonants on both dials and placing them before and after Y, the only word which is made is "pyx," which is the name of a little vessel used for religious purposes.

A WINDMILL FROM A SQUARE OF PAPER

WE can make an excellent picture of a windmill, with its sails all set, like the one shown on this page, by simply cutting up a square of black paper into ten pieces and pasting them down upon a sheet of cardboard.



1. The paper marked ready for cutting

We take a piece of black paper such as may be bought at any stationer's shop, measure off a square, and, placing it upon the table with the white side uppermost, rule pencil-lines upon it, like those shown in the first picture. Then, with a sharp penknife, cut the paper up into ten pieces as marked, and paste these down upon the cardboard in the positions shown. The windows and door are formed by pasting the little pieces of paper which form them upon the cardboard, with the white surface uppermost, and the bars of the window and panels of the door may be drawn with pencil. In this way every piece of paper is used up, and we have quite a good picture of a windmill.

2. The windmill completed

THE NEXT THINGS TO MAKE AND THINGS TO DO ARE ON PAGE 2969

WHAT THE WISE MAN TELLS US

THE Wise Man tells us in these pages why it is that children really rule the world, and why the future welfare of a race or of a nation depends so much upon the proper nourishment and care of their minds and bodies. He tells us too why the big open green stretches of the country are so much healthier for people than the crowded city streets; and he tells us what it is that makes us grow old and gives us crow's-feet and wrinkles about our eyes and mouths and how the different kinds of wrinkles either make us cross and disagreeable looking or pleasant looking and full of fun. Of these and many other interesting things the Wise Man tells us. Let us read for ourselves and hear what he has to say upon a dozen questions or more that are puzzling our brains. There will be some things which we will learn, too, about which perhaps we have never thought to wonder, as for instance, Why is a star star-shaped, or why can a hammer break a stone when a piece of wood cannot.

WILL THE CHILDREN RULE THE WORLD?

CONTINUED FROM 2802

IT is really true that the children of to-day will rule the world to-morrow. There is nothing we know better than that all men and women, kings and beggars, great and small, began as helpless babies, more helpless than any other kind of living creature, and there is nothing we more constantly forget. All individuals are mortal, and the destiny of the world, the ruling and the being ruled, is all in the hands of the children. Those who rule to-day were the children of yesterday, and will be dust to-morrow. That is the law of human life. It means that "a mother is the holiest thing alive," that history is made in the nursery, that the bringing up of children is the noblest, the purest, and the most necessary work in the world. And it is the most difficult, just because the human being is so wonderful and complicated in the nature of his mind and his body. When at last men come to see that real patriotism, real love of one's country, means, before all things, strengthening and ennobling its human life, and that, since we all must die, this means living to serve children—then not only shall we have the world ruled for children, ruled so that they shall be rightly prized, and nourished, and guided, and loved and taught; but also these children will, in a few years, grow up, and the world will be ruled by them. The writer has two little daughters. He knows that the highest thing a woman can be is a mother, a maker of the life of mankind. He hopes that they will one day have children; and he lives and works to teach all who will listen, so that the children of to-day, and their children, may live in a better world, where no child starves, or cries, or works, or dies, or is afraid, or cold, or lonely.

WHY CAN'T A BABY TALK WHEN IT IS BORN?

There are many reasons. One is that the baby needs a lot of practice before it can get control over the muscles of its lips and throat and tongue, so as to speak. Even grown-up people, when they learn a foreign language, may fail ever to "get their tongues round" sounds which do not occur in their own language, and every nation accuses every other nation of using "jaw-breaking" words. Another reason why

the baby cannot talk is that the part of the baby's brain by which talking is done is not developed when it is born—neither the part which hears sounds, nor the part which reproduces those sounds.

But the chief reason is that language entirely depends on imitation. We learn to speak by imitating the sounds we hear, and the baby cannot do this until it hears them, and then learns to distinguish them.

The more we study talking, the more wonderful we find it. There is nothing more marvellous in the world, though it is so common, than to watch a baby or a child learning to speak. If a human being, after being looked after for a little while, is entirely left to live by himself, as occasionally has happened, he cannot talk, but can only scream, or grunt, or point to things. It used to be thought that a child left to itself would speak in Hebrew, as that was thought to be the language of the Garden of Eden. As a matter of fact, a child left to itself becomes an idiot, and can hardly be recognised as human. "We are members one of another."

WHY CANNOT WE SEE VERY SMALL THINGS WITH OUR NAKED EYES?

If the retina, or curtain, at the back of the eye were a perfectly smooth, continuous thing like a piece of glass, we should be able to see much smaller things than we do. But it is a living thing made of living cells, and each of these can only see, so to say, one thing at a time. They are a certain size, and take up a certain amount of room, and there is a certain amount of space between them. Thus, the rays of light from a thing must be spread out enough to cover at least two of these cells—perhaps more—before we can expect to see two things separately. Of course, much depends on brightness. If a thing is very bright indeed, it will be seen by one cell of the retina, perhaps. Thus, a star may be seen, though the pencil of light from it is very narrow, while a tiny speck of something under our eyes, which sends a pencil of light just as big, will not be seen until we use a microscope. A large number of the stars we see are really double stars. The telescope shows us this by throwing the light on to more cells than one of the retina of the eye.

WHY IS THE COUNTRY HEALTHIER THAN THE TOWN?

The country is healthier than the town only for two reasons, but they are very important. They are that the country gives us purer air to breathe, and more sunshine, as the country air is clearer and does not stop so much of it as town air does. On the other hand, the towns are usually much better off than the country in the matter of sewers and of water. Further, if people are wise and reasonable, it is better for their health of mind to see *not too few* people, and to be not too much forced in upon themselves. In this way the town is better than the country; and it is a fact that there is more insanity in the country than in towns. It is foolish to abuse cities blindly, as many people do. Civilisation really means *city-fication*. There never has been a civilisation without cities. Athens, and Rome, and Jerusalem, to which we to-day owe almost everything, were cities.

The time will come when people will see this, and will try to make their cities as healthy as the country in air and sunshine. They will not allow each other to make the air impure, and so they will get better air into their lungs and more sunshine; they will build all houses with gardens; they will stop the unnecessary noises of cities; and so will make places where men can meet, and gather, and mix, and make music, and hear each other speak, and discuss things, and do everything which men must do together—while they will keep the advantages of the country.

WHAT IS A GARDEN CITY?

Wise people, instead of trying to abolish cities, are now beginning to build cities of a new kind, which are called Garden Cities. Some day, no doubt, all cities will be of this kind. Every house in a garden city stands free of its neighbours, and has its own garden. The roads are wide and well provided with trees. The rich amount of green leaves helps to purify the air, and the people are not so overcrowded as to make it foul. Smoke is not allowed to come out of chimneys. There are many ways of consuming smoke and making it useful instead of dangerous. No one is allowed to buy a piece of land and cover it with slums. There is a splendid garden city, the

first in England, near Letchworth; and certain wise employers have built smaller places of the kind. As we might expect, fewer babies die in one of these garden cities—Bournville, near Birmingham—than in any other place of the size in the whole of England. The next thing that may happen, as people begin to learn good living and good government, is that the land round cities will be bought by the city and used properly, instead of being bought by private people to make money out of, at the cost of thousands of lives. This is already being done in Germany and Australia.

WHY IS IT THAT SO MUCH OF NATURE IS GREEN?

Wherever life can find a footing in Nature, there we find it. It varies in a thousand ways, but we find it almost everywhere. It is always limited, and decided by the food supply; and thus we find it most abundant where the food supply is most abundant. Thus, the distribution of living things depends on the distribution of the kind of food that they live upon. If that is widely distributed, so are they; if the food is not widely distributed, neither are they. Of all the possible foods for life, by far the most widely distributed is carbonic acid, as that occurs in the air, and so is to be had wherever the air is. Thus, the most widely distributed kind of life is that which is capable of feeding on carbonic acid, and the only kind of life which can do this is that which produces the green substance called chlorophyll—one of the most important chemical compounds in the world. That is the reason why so much of Nature is green. And if we know the relation of the green plant's life to our own, we should learn that there *must* be a certain amount of green life in Nature, if we are to live. At present we destroy green fields and cut down green trees without any thought—for our cities, and tables, and so on. But much of Nature must always remain green, unless man learns how to use the carbonic acid of the air as the green plant does; and of that he shows no sign at present.

WHY SHOULD LIGHTNING STRIKE CERTAIN THINGS AND NOT OTHERS?

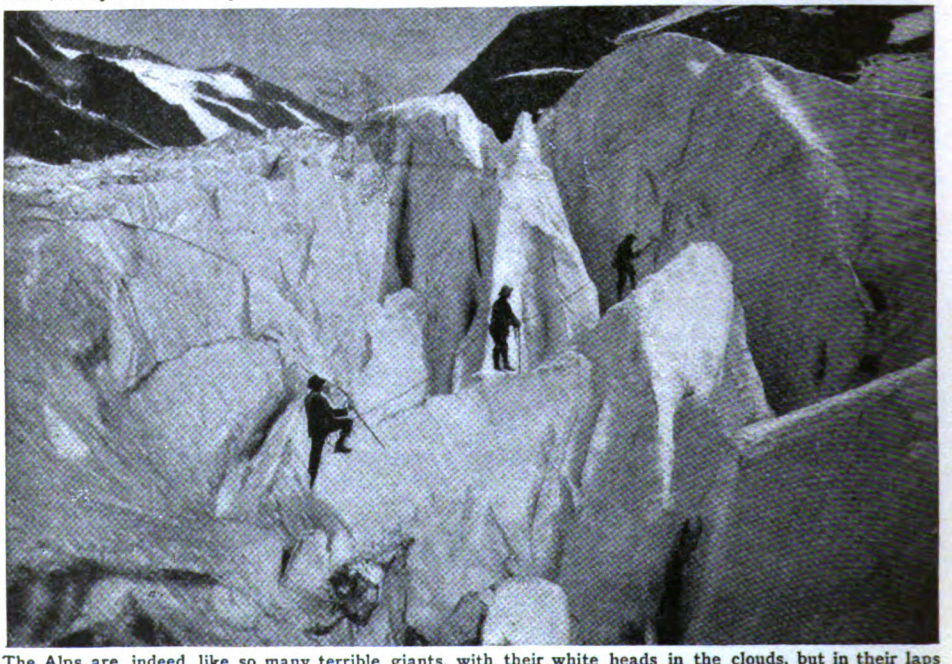
We know that if lightning can choose between a lightning-rod—that is to say, a rod of iron—and the rest of the roof of a house, it will go down the rod. We know that it will always choose metallic things rather than any others. And it will strike a tree rather than the ground beside the tree. In every case the principle is the same. It is that electricity will always choose the easiest path. The usual way of saying this is that it takes *the path of least resistance*, and the principle is true of many things besides electricity. It is often true of ourselves. Thus, if the electric current can pass to the earth through a tree, it will do so, because the tree helps its passage downwards. That is why we should never stand under a tree during a thunderstorm. But, for choice, it will always pass through anything made of metal, such as iron, for the whole group of metals are good conductors of electricity—the best there are. We do not know *why* they conduct it so well, but we do know that that is the reason why lightning chooses to pass through them. So a lightning-rod will protect a house, provided that it runs right down into the earth. If the lower part of the rod has rusted away before it reaches the earth, as sometimes happens, the electricity will be discharged into the house, and then the rod does more harm than good, for it attracts the lightning to the house, and does not protect it.

WHY DO WE GROW OLD?

This is a most difficult question, which some of the wisest men now alive are trying to answer. The chief reason seems to be that gradually there is heaped up in our bodies a certain amount of the waste products of our lives. We get rid of most of these quite easily, especially the gaseous ones, like carbonic acid. But there are others which we do not completely get rid of, and at last they poison us, make our limbs and joints stiff, our hair fall out or turn grey, our skin shrivel, and so on. This process takes much longer in some people than in others. It is strictly true to say that some people are older at forty than others are at seventy. This teaches us that it is not the mere passage of time that makes us old, but what is happening during that time in our bodies. People who lead wise lives, especially people who do not eat too much or drink too much, and who get enough sleep, during which the body

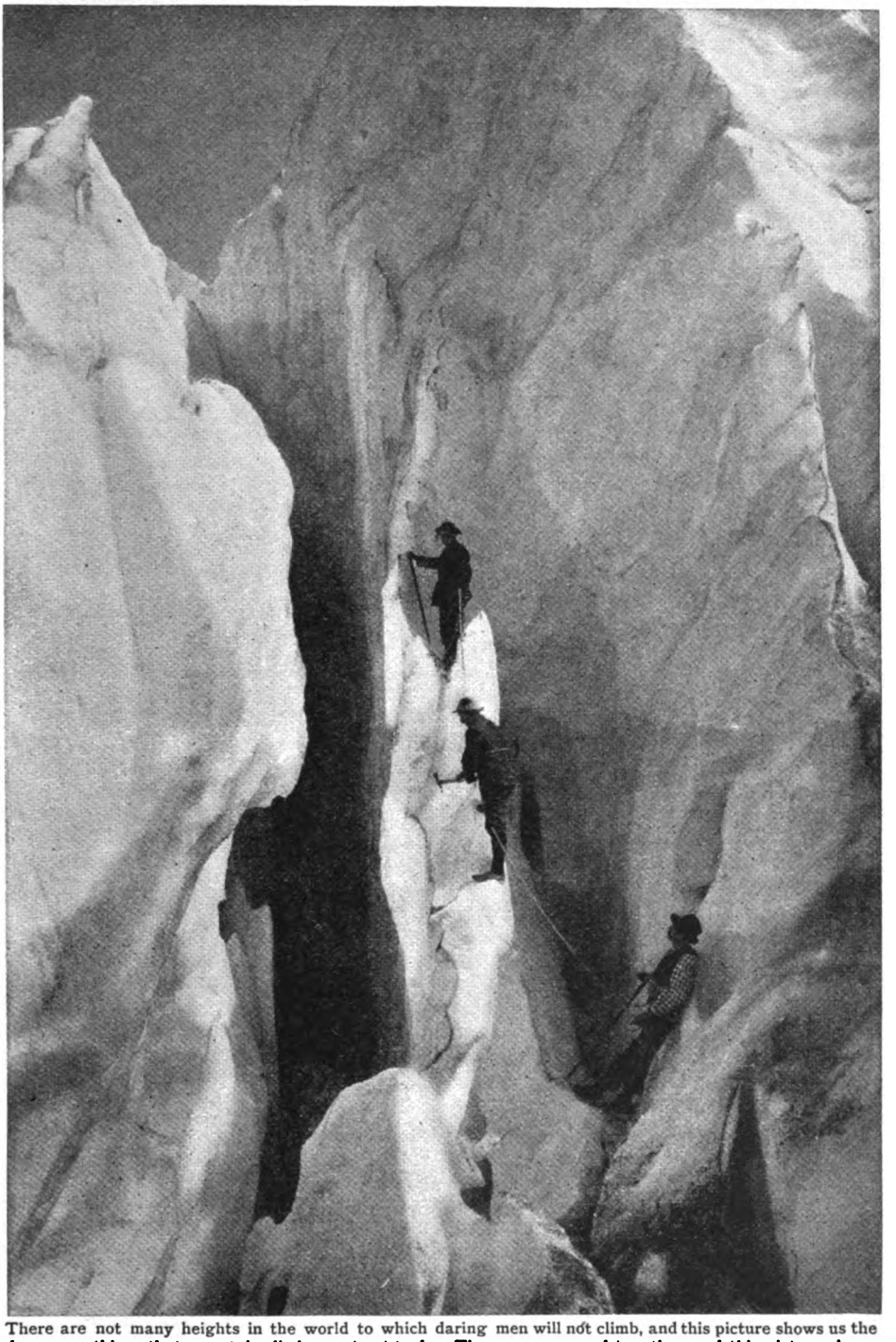
THE HIGH PEAKS OF WONDERFUL MOUNTAINS

Although these mighty snow mountains of the Alps seem so unfriendly to man, and so far away, it is only the tops of them that are uninhabitable. For lower down their vast and tree-covered sides there are many villages, and in the cosy valleys between the foot-hills of the Alps there are bright and happy towns, merry with the noisy waters that run in rapid tumbling rivers from the melting snow of the glaciers.



The Alps are, indeed, like so many terrible giants, with their white heads in the clouds, but in their laps they let men build their towns and live in peace, though now and then they let slip the dreaded avalanches, which may sweep away a village that has built itself too near the white heads of these giant mountains. It is wonderful to think that an African army, with thousands of horses and elephants, led by the great Hannibal, crossed these mighty Alps more than 2,000 years ago. Napoleon also took an army over the Alps.

CROSSING A CREVICE IN THE ALPS



There are not many heights in the world to which daring men will not climb, and this picture shows us the **dangerous things that mountain climbers set out to do. The men are roped together, and this picture shows them on their way up the Alps, gazing into the vast depths of a crack in the mountain-side which they are about to cross. Sheer above them rise the snow-clad sides of a great white mountain, the top of which they hope to reach. Many men lose their lives in climbing to these great heights and crossing over these deep depths.**

The photographs on these pages are by G. P. Abraham, Keswick.

gets rid of and destroys many of the poisons it produces in the daytime, do not grow old nearly so quickly as other people. Also this is true of people who have quiet minds. Great worry or sorrow "ages" people, as we say; it interferes with the power of the body to recover from exertion and to get rid of its poisons, and so unhappy or fretful people get old more quickly than those who lead calm and happy lives. The people who take longest to get old are those who act on two good proverbs: "The best doctors are Dr. Quiet, Dr. Diet, and Dr. Merryman"; and

Joy, and Temperance, and Repose
Slam the door on the doctor's nose.

WHAT IS IT THAT MAKES WRINKLES?

The wrinkles of elderly people are due to a slow process of wasting in the skin. It is a curious thing that we can, by good sense and cheerful minds, control the process of going old in everything that matters, and especially in our brains, but we cannot in the case of our skin—just where old age shows most, and just where it matters least. The skin gets shrivelled and puckered, and especially do we notice wrinkles in people who have got rather thin, for this means that a good deal of fat has disappeared from under the skin, so that it is too loose for the body, and falls into wrinkles. In extremely old people, perhaps ninety years old, the skin gets so thin, and so much of it wastes away, that all the wrinkles disappear, and their faces get quite smooth.

There are different kinds of wrinkles that look very different to our eyes. In people who have often scowled and been angry, and have often felt hate or hardness to other people, the wrinkles which form on the face tell their tale. We say that such a person has a hard face, and children usually run away from such a person; and in other elderly people, who have often smiled and sympathised with others, and have had cheerful lives, and tried to make others cheerful, the wrinkles form round the eyes and mouth in a way that makes them look kind and nice; and children, who are very wise in such things, usually take to these people at once.

WHY DO I JUMP WHEN I GET A SHOCK?

The jump when we get a shock, or the closing of our eyelids when something comes near to them, is called a *reflex action*. Reflex actions are constantly occurring in our bodies, and in those of all living creatures, and we could not live without them. They are called "reflex" because the action follows at once on the thing that excites it, almost as if it were a ball or something reflected from a wall. The mark of a reflex action is that the *will* is not concerned in it; and that is the whole point of this question. We do not want to jump, we do not make up our mind to jump, but we jump first, and then notice that we have jumped. The will does not cause reflex actions, but it can often control them if it has time and warning given to it. That is why we jump at an unexpected sound, as when someone bangs a door; but not at an expected sound, as when we bang the door ourselves.

WHY DO PEOPLE PUT A MARBLE IN THE KETTLE?

The water we boil in a kettle is never pure water, but contains many things. It contains salts, which are apt to be deposited in the kettle as the water boils away. It also contains acids, which are able to act on the iron of the kettle, and turn it into salts of iron, which also fall to the bottom; besides this, they are actually made by the water from the inside of the bottom of the kettle. I suppose, then, that people have noticed that if they put a marble in the kettle, it collects these salts and prevents these things from settling inside it, and keeps the inside of it smooth.

WHY DOES A BICYCLE KEEP UPRIGHT?

In answering this question, we may teach ourselves the way in which we try to solve questions like this. We know that the bicycle does not keep upright when it is still, but it does so when it is in motion. The same is the case with a hoop. The more a bicycle or a hoop moves, the more surely does it tend to keep upright. There must be something, then, in the nature of motion that keeps the bicycle upright; not something in the bicycle itself, or else it would keep upright apart from its motion. When we have gone so far as to realise this, we may hope to find the answer to the question, for we have our attention fixed on the point which contains the answer. Now let us consider what we know about motion, and see whether that will explain this case.

Some of us, who have read this book carefully, will now be able to answer the question. Newton's first law of motion must be the answer. This says that a *moving* thing will move at a constant speed *in the same straight line* for ever, unless it is acted upon by some other force. That is what happens to the bicycle or the hoop. It is a *moving* thing, set moving in a certain direction, and, according to the first law of motion, it *must* go on moving in that same line until something interferes with it, and so it keeps upright.

WHAT IS INERTIA?

We probably know what we mean when we say that anyone is *inert*. It means that he does nothing "of himself," but has to be made to do anything he does, and that he is even then only *passive*—acted upon, not *active*. *Inertia* is thus the name given to the property of matter by which, in the question of motion, it is inert. If at rest, it remains at rest until something acts upon it. If moving, it goes on moving, changing neither its direction nor its speed, until something acts upon it. In other words, the first law of motion, which explains why a bicycle keeps upright, is the law of inertia. It says that, so far as motion is concerned, matter is passive, resting unless something moves it, and moving unless something brings it to rest. This inertia, or passiveness, or tendency to go on doing what is being done, is also, I think, the first law of mental motion. Our minds do not move unless and until something moves them; and when we have got "into a groove," as we say, we are apt to stay there until something jogs us out of it. We have specially to remember what people usually forget—that inertia, of matter or of mind, is shown in the going on until something interferes, as much as in resting until something interferes.

WHY HAVE THE STARS JAGGED EDGES, NOT ROUND, LIKE THE MOON?

This is one of those many cases where what we seem to see is not at all in what is outside us, but is in ourselves. If we look at the stars through a telescope, or if we have perfectly shaped eyes ourselves, or use spectacles very accurately made to suit our eyes, the stars do not always seem to have jagged edges, but may be seen as sharp points of light. So part of the answer to the question is that the eyes of most of us are not quite perfect in the way they throw the light on the retina, and that this defect causes a blur, and is revealed especially when the thing we are looking at is very small; or, rather, seems very small, as the light from it only strikes upon a very tiny portion of the retina. It may be, also, that this appearance of the stars is partly accounted for by a special fact about the eye which is called *irradiation*. This means that the image of any bright thing is apt to spread itself out, or *irradiate*, in the eye, so that it seems to excite parts of the retina on which the light is not really falling at all. The excitement spreads a little, rather as a dot of ink, made on some kinds of paper, spreads a little round it—and so the thing we look at seems bigger than it really is, and often a little irregular in shape.

WHY IS A STAR STAR-SHAPED?

When I had answered the last question about the stars, said the Wise Man, I thought I had better go out and see the stars, as it was a clear night, and the first I saw was Capella, one of the finest in all the sky. It lies below and to the left of the L of Perseus, as everyone should know. And though I was wearing accurate spectacles, Capella was most perfectly star-shaped, with four beautiful points at equal distances from each other all round its edge. This perfectly regular figure, which has been noticed in all ages, and from which the starfish gets its name, is undoubtedly due to the structure of the eye, and it seems to depend partly on the state of the eye at the time, as we do not always notice it. It is never seen in the photograph of a star. When we study the arrangement of the sensitive points in the curtain of the eye, it seems that the sharp, bright image of the star falls upon one of them only, and then, by a sort of sympathy, affects equally those that are packed around it, and we may perhaps find that the arrangement of these *cones*, as the sensitive spots in the centre of the retina are called, is just such as would account for the appearance of a star. It is probable that no other thing but a star produces a pencil of light so fine as just to strike directly one cone of the retina, and only one.

WHY IS FIRE COOLER THROUGH GLASS, IF GLASS MAKES THE SUN'S RAYS HOTTER?

This would, indeed, be a puzzle if it were true. It would mean that the radiant heat from a fire is somehow different from the radiant heat from the sun. It is true that glass cuts off the heat of a fire, as everyone knows who has used a glass screen in front of the fire. But it is not at all true that the sun's rays are hotter through glass than in the open. The glass of a greenhouse cuts off a good deal of the sun's heat, just as it would cut off the heat of a fire. But the air is kept in the greenhouse, and so gets hotter and hotter. It gets the heat and keeps it to itself, so that it does not get out again. So a greenhouse, though it keeps out some heat, gets hot because it is *a trap for heat*, and keeps what heat it does get. Of course, the sun does not always shine, and so we have to have hot-water pipes in a greenhouse to make the air hot when the sun does not. A tent acts in the same way; and everyone knows how hot the inside of a tent gets. It cuts off a lot of heat, but it lets some through and then traps it by making it heat the air which it confines within itself.

HOW DOES THE SUN MAKE A MAGNIFYING GLASS BURN A PIECE OF PAPER?

This question would be better put the other way round—how does a magnifying glass make the sun burn a piece of paper? Just in the same way we say that the sun makes the green stuff of the leaf decompose the carbonic acid of the air, but we should say that the sun does it by means of the leaf. Always the sun is the real cause. In this case it is the concentrating power of the lens that helps the sun. We know that when light passes through a convex lens it is bent towards the thickest part of the lens—which is the centre—and that the rays are all brought to a point, which is called the *focus*. We see this when we make the experiment of burning paper. We see the light brought to a focus, but it is not the light that burns the paper. If, instead of the glass, we had a hollow globe filled with cold water, kept changed, the light would be thrown on the paper just the same, but it would never burn. It is the heat-rays of the sun that burn the paper, and the interesting thing, which we must be careful to remember, is that heat-rays are bent by lenses exactly as light-rays. The two kinds of rays obey exactly the same laws, which is natural enough, since they are varieties of the same thing, though we happen to feel the one and to *see* the other. Of course, no heat is made out of nothing in this case, or in any other case. The paper round the bright centre loses the heat which the centre gains.

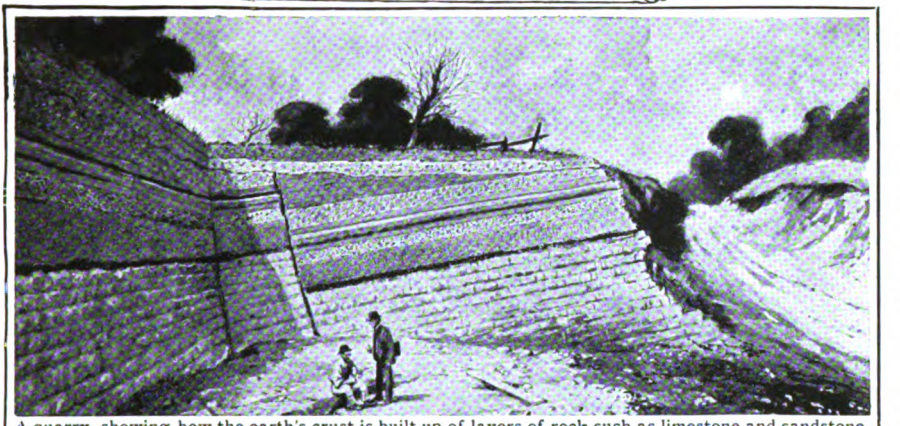
HOW IS IT A HAMMER WILL BREAK A STONE, BUT A PIECE OF WOOD WILL NOT?

A stone is held together by a special kind of force in the molecules that make it up. This force is called *cohesion*, or sticking together. When the stone is broken this force is overcome, so that the molecules are forced apart. Now, if a force is to be overcome it must be by a stronger force. It must be, then, that there is more force in the blow of a hammer than there is in the blow of a piece of wood, and that is so. The reason why the hammer-stroke is more forcible depends upon the heaviness, or mass, of the hammer. Let us suppose that the wood is moved at the same rate as the hammer. Then the hammer is more forcible in proportion to its greater mass. If the hammer were moved slowly, and the wood very fast, the stone would break if the wood did not. The force of a moving body depends on two things—its mass, and the speed at which it moves.

CAN A FISH SEE AND HEAR US?

If we go to an aquarium, or to the fish-houses at some Zoological Gardens, we shall soon see for ourselves that fishes can see us, and see very well and quickly, too. Every fisherman knows this. He knows, too, that fish are very particular about colour, and that they catch things by sight as well as by smell; for a fisherman's flies are not scented, but coloured, and the fish come to them very readily if they are of the right kind. Then we all know that fishes have eyes, for we have all seen them, and they are quite highly developed eyes, not so very much inferior to our own, and made on much the same pattern. On the other hand, fishes are decidedly inferior to us in hearing; though they are by no means deaf, they do not respond to music as they seem to respond to colour.

The next Questions are on page 3031.



A quarry, showing how the earth's crust is built up of layers of rock such as limestone and sandstone.

THE EARTH'S CRUMBLING CRUST

CONTINUED FROM 2866

As we have learnt, astronomers are trying to understand a little of the history of some of the heavenly bodies. We know a very little of the history of the stars, and this is helping us to learn something about the history of the sun. As regards the history of the moon, we might expect to be able to learn a great deal, but this offers many difficulties, and, indeed, there are many careful astronomers to-day who declare that even what we call the volcanoes and craters of the moon are not really volcanoes, but are the marks of scars left upon the moon after its surface, unprotected by any atmosphere, has been struck by huge meteors. The lesson we have to learn is that explanation, or interpretation, as it is called, is very difficult, and must only be made after description.

If now we turn to our own earth, we shall expect here, at any rate, to be able to read a definite history. Not only have we the moon, as it now is, and the differing states of the various planets such as Mars and Jupiter to guide us, but the earth's crust is under our very feet; we can dig mines in it; we can make still deeper borings in it; we can study the sides of its great gorges; we can climb its mountains, and so we should be able to read its history. It has been necessary, not once, but often, in what we have already learnt, to refer to this study, which is called Geology. We have learnt a little, for instance, of the part that water plays in the history of the earth; we have heard about the element radium, which helps to keep the earth's crust warm; we know that there are rocks which were formed by water, and rocks which were formed under the influence of heat. We shall now make a survey of the main facts and ideas of geology, enough for us to be prepared to follow what the geologists shall teach us in the future, for our best knowledge of geology is no doubt yet to come, and will be coming very soon.

We all know that there has lately occurred in the south of Europe the greatest and most deadly earthquake recorded in human history. Now, it is earthquakes, and the eruptions of volcanoes, and the other violent things which occasionally happen that tempt us all into an utterly wrong idea of the earth's history—an idea which, though wrong, was generally believed in by geologists until about seventy years ago. We are apt to think that it is the violent, exceptional things that have made the history of the earth, earthquakes, hurricanes, tidal waves, and so on. We notice nothing else happening, or if we do notice such a

thing as that the bed of a river is getting rather wider or deeper, we cannot imagine that such little and slow things can count for much. We look at the history of the earth just as historians, up to now, have looked upon the history of mankind. One of the greatest authors of modern times has written words which are for ever a lesson to historians of mankind and to students of the earth's crust. In his book on the French Revolution, Carlyle tells us how the oak grows for a thousand years in the forest, little by little, and no one takes any notice; then perhaps it happens that the lightning destroys it, and everyone records the fact.

THE HISTORY OF THE WORLD IS BEING MADE IN EVERY NURSERY ON EARTH

The truth is that the history of men is being made at this moment in every nursery on the face of the earth; and the history of the earth's crust, like the history of man, is really made, from moment to moment, by little things which do very little in a moment, but do a great deal in a million years. We need not here trouble about the long words which describe the two opposing schools of geology. It is enough for us to know that victory all along the line lies with the newer school, who believe in the slow, continuous making and changing of the earth's crust, as against those who believed that the earth's history has been alternately periods in which nothing happened, and times of destruction in which all life was killed, and then a fresh start made.

The newer and truer view not only helps us to understand the past, but it transforms the study of geology for us to-day, because we to-day, as we cross a stream, or see the rain fall on a rock, or play with the sand on the seashore, can see and watch for ourselves the slow happenings which have made, are making, and will make the history of that narrow belt between earth and sky which gives birth to all living things.

PERHAPS ANOTHER SHAKESPEARE OR ANOTHER NEWTON WAS BORN TO-DAY

This is a great idea, and it applies equally to human history. We find that there is no news in the papers, and we think that nothing is happening. We are very wrong. Perhaps another Newton or another Shakespeare was born to-day, or a baby who will become a politician and save or destroy his country. Human history is always being made. This book is making it; we are making it, as we are writing or reading these pages; and the rain at this moment outside is making the history of the earth's crust. But it is one of the laws of our minds that we do not notice what we are accustomed to. What really catches our attention is something that is new, or big, or quick. As long as the ball of paper is still, the cat will not move; we twitch it and the cat sees. We also see when things are twitched. We put our history, or the earth's history, down to battles and earthquakes, not to the quiet mothers whose names are unknown, nor to the rain and the dew falling where no one sees them. The greatest thing that science has to teach us is that history is always being made everywhere, and that only what might be called the bubbles, and froth, and splashings of it—that are called earthquakes, and battles, and so on—get into the newspapers and the history book.

HOW GEOLOGY TELLS US THE STORY OF THE EARTH

So now, having already learnt what is by far the greatest lesson that geology has to teach us, we may go on to look at the main facts of the earth's crumbling crust. We must borrow help from almost all the sciences; we must know everything that geography can teach us, for the geography that deals not with cities, but with mountains and rivers and so forth, is simply the latest chapter, but not the last, of geology.

We must learn everything that the chemists can teach us about the atmosphere and the weather. If the chemist finds carbonic acid in rain, and can prove that that carbonic acid helps to melt the rocks, that is part of geology. If students of the wind observe how it alters the surface of things, that is part of geology. We must study, where we can, the results of frost and rain, waves and tides, rivers on the surface or under the surface, glaciers or ice rivers. These are the tools of earth sculpture. If we watch them at this moment, we can see them carving, moulding, biting, smoothing, wherever there is dry land, and so we can learn to read the history of the earth. Geology also borrows from the students of earthquakes and of

volcanoes. The greatest results of earth sculpture, we know, are the mountains. Is it earthquakes and volcanoes that have built the mountains? Up to the present this has been generally believed. But geology, which is the borrowing science, borrows also from chemistry, and in the twentieth century chemistry is beginning to teach that there are elements of which radium is the type, our study of which will utterly change our ideas of mountain building.

HISTORY & POWER ARE NOT IN VIOLENCE, BUT IN THE STILL SMALL CAUSE

As in every case before, this new change, which is only just beginning to take place, is in the direction of teaching us that the sudden, big, disastrous, sensational things, like earthquakes, are not the most powerful forces at work; or if they are the most powerful, they are not the most effective. Earthquakes have had something to do, no doubt, with mountain building; yet it is more likely that at least one great agent of mountain building has been the slow but steady change in the earth's crust produced by the presence of radium, which is a ceaseless maker of heat with all its consequences.

But the borrowings of geology are not yet ended. It learns a great deal from that department of chemistry which is called mineralogy, or the study of minerals. Everything mineralogy has to teach about crystals, how they are made and how they break, how they are melted, what they weigh, how hard they are, and so on; and not only these things, but also the places where minerals are found in the earth, how they lie in veins, as they are called—all these things come to form part of geology. Nor has this exhausted our sources of knowledge. Everything we know about life contributes to geology. The rocks have records of many forms of life, some of which are utterly different from any now existing, while others cannot be distinguished from living forms.

THE WONDERFUL WAY IN WHICH WE LEARN FROM BURIED ANIMALS

Geology gains enormously from the study of these remains, and it is no less true that the study of life gains greatly from geology. Indeed, the record of the rocks and the record of life are largely one. Unfortunately, the rocks have not yet taught us all we might hope to learn regarding the history of life. It is now over fifty years since the publication of that great book "The Origin of Species," in which Charles Darwin discusses what he called the imperfection of the geological record, and that record is still imperfect. But if we come to think of it, there is something wonderful in the fact that fossils are preserved at all. We need not wonder that they are so few. If we consider how many conditions are necessary for a fossil to be made and preserved, we shall wonder that they exist at all. Frost and rain and the sea, dripping water, pressure, heat produced by lava, and so on, must have destroyed countless millions of fossils; nor is the body of every kind of living creature fitted to produce a fossil at all.

But the people who complain that the rocks do not teach us what we should expect about the history of life forget how very little of the rocks we have yet studied. To begin with, only two-sevenths of the earth is at present above water. Every portion of that has no doubt been below the water, and the present ocean-beds have at one time been dry land covered with life.

THE KNOWLEDGE THAT HAS GROWN FROM THE STUDY OF A BIT OF THE EARTH

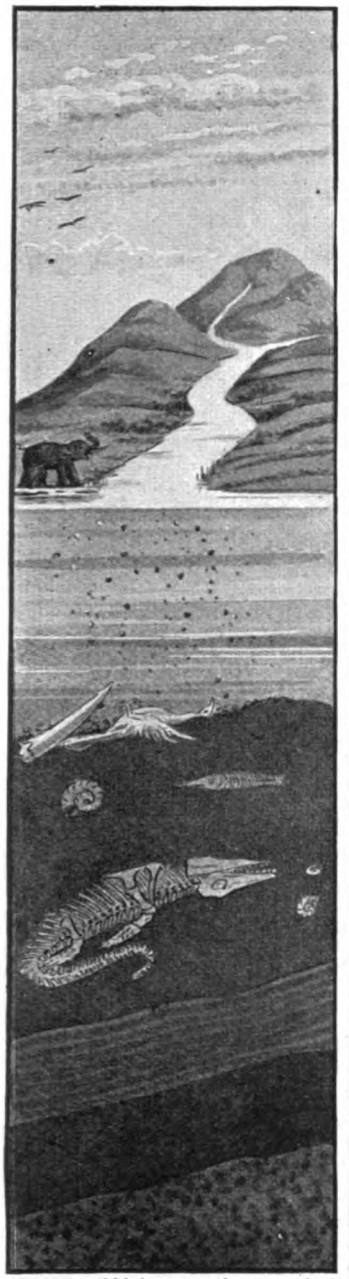
All we have access to is what is found on these two-sevenths, which is by no means necessarily the most important part of the globe so far as the history of life is concerned. But even of this portion only tiny points have been studied, especially a good deal of Western Europe, with bits here and there elsewhere. We have not begun to examine properly anything like one-thousandth part of so much of the earth as we can examine at all. The really marvellous thing is that so little inquiry has produced so much result. We should know that latterly these results have dealt not only with the past history of animal life, but with the past history of vegetable life. During the last century we have actually discovered scores of thousands of different species of fossils, and, as Professor Huxley said, "we have no more ground for doubting that these creatures really lived and died at, or near, the places in which we find them, than we have for doubt about a shell on the seashore. The evidence is as good in one case as in the other."

The history of the earth for millions of years is written in its rocks, and men are able to read what took place, and to give us, in pictures like these, a vivid panorama of the earth's long wonder-story. We can see also just how that story came to be written in the rocks. A million years ago, a little stream trickled down a mountain-side, carrying with it grains of sand and stones, which fell to the bottom of the sea. In the sea swam a great and wonderful creature called an ichthyosaurus.

The ichthyosaurus was a reptile that lived in the sea, and its name means "fish-lizard." It had a great head with powerful jaws and teeth, and its body had four limbs like paddles which enabled it to swim about. One day the great creature died, or probably it was killed in battle with another strange monster, and its body fell to the bottom of the sea amongst the shells and seaweed. Meanwhile, the stones and sand brought down by the stream continued to fall upon the bed of the sea.

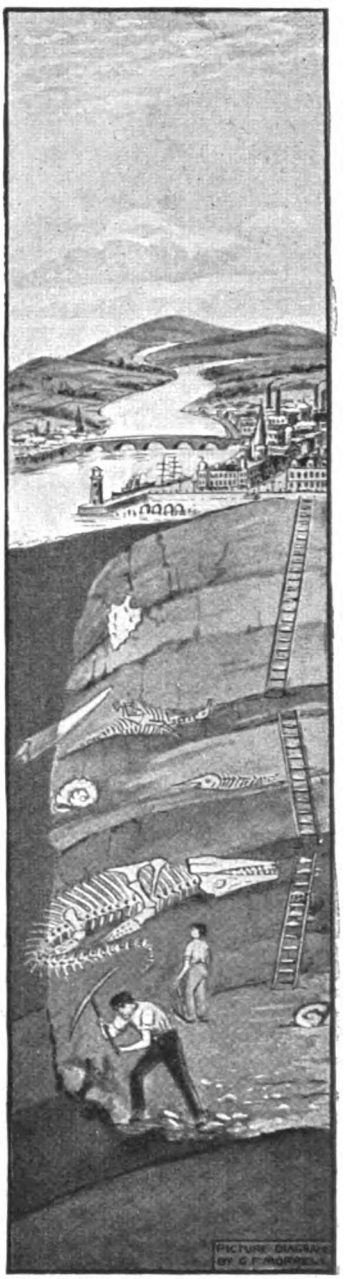
As the ages passed, the stream gradually wore away a wider and deeper bed for itself, and became a big river; and the rains falling upon the mountain loosened the soil and formed hundreds of tiny streamlets. These all ran into the main stream, and each did its part in wearing away the mountain. As the river became wider, so it brought down more and more earth and stones, which fell in a never-ceasing shower upon the bed of the sea, until at last the great reptile's body was buried.

THE WONDER-STORY TOLD IN THE ROCKS



Higher and higher rose the ocean-bed as the mud from the mountain continued to fall upon it, and the lower layers became pressed into hard rock by the weight on top. One day an elephant going to the river to drink broke off his tusk, and this was carried down by the river and sank in the sea. Another day a bird was drowned, and this, too, fell upon the ocean-bed. Dead fishes and shells also sank, and all were buried by the never-ceasing shower of mud and earth and sand and stones.

All through these ages the rain and river were wearing the mountain away. Hundreds of thousands of years after the ichthyosaurus died, men began to live on the earth, and one day a man who had made a boat out of a hollow tree-trunk took his wife and went out to fish Trying to spear a big fish, the head of his harpoon broke off and fell to the bottom of the sea. It was too far down for the man to recover it, and in course of time this also was buried in the mud.



The bottom of the sea crept higher and higher, till at last it became dry land. Then one day men began to dig, and the world's wonderful story was revealed as we read it here. First the spear-head was found, then the tusk, the bird's skeleton, the shells, the fish, and at last the skeleton of the great sea reptile, all turned to stone and become fossils, a word that means something dug up. Only a year or two ago, a great fossil skull was dug up in Fleet Street, London.

What we learn in this way is really a record composed of mud, and though we might suppose that it is not worth anyone's while to ask how mud is formed, yet the answer to this question is a key to a great deal of geology. Mud is formed by the action of water, wearing down the surface of the earth and rocks with which it comes in contact, pounding and grinding them down, and carrying the pieces where they can rest together.

ROCKS THAT ARE NOW BEING MADE AT THE BOTTOM OF THE SEA

Every wave of the sea as it breaks on the shore does this; and thus, to quote the words of a great authority, "slowly but surely the hardest rocks are gradually ground down to a powdery substance; and the mud thus formed, coarser or finer, as the case may be, is carried by the rush of the tides or currents, till it reaches the comparatively deeper parts of the ocean, where the water is so calm that the finest particles can sink to the bottom."

In a similar way the river carries part of the land into the sea, and so layers of mud are formed at the bottom of the sea. These gradually harden, and make a record of time. When they are hard, we call them sandstone or limestone, or whatever the rock may be. The surface of the earth is made up of these rocks, of which we know a thickness of not less than 70,000 feet. They are being made now. Such chalky rocks as we know are found at Dover, for instance, are actually being made at this moment at the bottom of the Atlantic.

A tremendous story is written in these rocks. We know, for instance, what myriads of creatures are living in the sea, and when they die, their shells and hard parts, lying at the bottom, may be covered by the fine mud which is brought down by the wear and tear of the sea and the rivers.

THE STORY OF THE STRANGE THINGS THAT WE SEE IN THE MUSEUMS

This mud becomes hardened, and ages afterwards people may walk into a museum and see the piece of sandstone or limestone in which these remains are embedded. This process applies as well to many land creatures. It applies to such cases as where turtles' eggs were laid upon the sand, but before the sun had time to hatch them, were covered over with chalky mud. All this occurred unthinkable ages before mankind existed, and the results are now to be seen by us. Or the bodies of creatures may drift away to sea, or get buried in bogs, or be crushed into the mud at a river's bank.

It is, however, very rare to find the remains of a wild animal in fossil form. Either they die where their bodies are not protected by mud, or the bodies are eaten. Not only so, but when the bones of an animal have been safely embedded in mud, they may yet be dissolved completely away by water containing carbonic acid. Huxley had some pieces of rock sent to him from Scotland which contained no fossils or bones, but holes only. When those cavities were filled with something, so that a cast was made of their shape, it was found that they corresponded to the vertebræ and part of the armour of some great reptile more than twelve feet long. As Huxley says: "This great beast had died and got buried in the sand; the sand had gradually hardened over the bones, but remained porous. Water had trickled through it, and that water, being probably charged with a quantity of carbonic acid, had dissolved all the phosphate and carbonate of lime, and the bones themselves had thus decayed and entirely disappeared."

THE GIGANTIC CREATURES OF THE PAST THAT LIE HIDDEN IN THE ROCKS

Now that we understand what fossils are, and how they are formed, we must learn what they teach us. This part of science has a special, long name of its own, and men may devote their whole lives to small parts of it. Here, of course, we want to know the great result of all this study, if there is such a result. We find, then, that these fossil remains, both animal and vegetable, correspond very largely with the living forms of to-day, and yet differ from them. If we were to walk through a museum containing fossil remains mixed up with those of creatures now living, it would only be when we looked closely that we should notice differences. One very notable exception there is to this, and that is the case of certain very large reptiles, very fierce looking and alarming, which no longer exist. Only lately have we learnt the astonishing size that these creatures attained, and no one should live in, or visit, New York without going to the Natural History Museum on

Central Park, to see the amazing skeletons of these extinct beasts that have been lately mounted there. Our study of the rocks thus teaches us something about life which we must notice here. It is that at one time Life tried the method of sheer bigness; tried it persistently and tried it thoroughly, and it failed. These creatures got to be as big as houses, but their brains were tiny, and the law of the world of life is that mind is the master of matter. Their size did not save them from the results of their stupidity. People who now devote their lives to the culture of their muscles, and forget the culture of their minds, may learn something from these monstrous reptiles of the chalk deposits.

A very vivid way of getting an idea of the rocks and their contents is to put down in order what we should come across if we began to dig, say, in Trafalgar Square, London. First, we should come upon beds of gravel or drift, containing the bones of large animals, of varieties now extinct, such as the elephant, rhinoceros, and cave bear. Such remains were found a year or two ago, including a magnificent skull, when builders were enlarging the office of a London newspaper in Fleet Street.

Below this we should come to the London clay, as it is called, containing remains of strange cattle, remains of turtles, palms, and large tropical fruits, with shell-fish like those we see now only in tropical regions. When that bed was forming, we understand, these regions were tropical. Below the London clay we come to the chalk. Creta is the Latin for chalk, and the proper name for this chalk is the *cretaceous* layer. Here we find the giant reptiles, and some reptiles that flew in the air and teach us where the birds have come from.

As we went farther down, we should find other remains of lower types, shells and remains of early fishes. The lower we went, the greater would be the difference between the living forms of which we found the remains and those that live now. After a time remains would become very few and simple, and lastly we should come upon layers which yielded no evidence of life, and, indeed, which correspond to a time when there was no life upon the earth, and when its crust was still in the fiery condition which we have studied under astronomy. Of course, we must not imagine that all over the earth we find a perfectly regular arrangement of layers without breaks. Here we have been describing

A SLICE OF THE EARTH'S CRUST

If we could cut a slice from the earth's crust it would look something like this. First we find remains of present-day animals, and stone weapons used by the early men.

Then we find the remains of the mammoth, the great Irish elk, and the woolly rhinoceros, which lived when the greater part of our earth was covered with mighty glaciers.

Next we find fossil bones of huge animals like the giant sloth, and of smaller creatures like the ancestor of our modern horses, that lived a million years ago.

Still lower we see the remains of the mighty mastodon, and a tiger with teeth like walrus tusks. On pages 30 and 31 of this book we see what all these fossils were like when alive.

Then we come to the chalk rocks, with their giant reptiles, their great flying dragons, and the remains of birds, which first began to appear in this age, perhaps three or four million years ago.

Lower down, the rocks contain remains of the gigantic "fish-lizards," with necks like snakes, that lived in the Age of Reptiles, six or seven million years ago.

Next we come to the carboniferous rocks, with their remains of mighty forests that have become coal, in the fifteen or twenty million years since they grew. Crocodiles appear in these rocks.

Still lower, we have the remains of fishes which existed when nearly all living creatures dwelt in the sea.

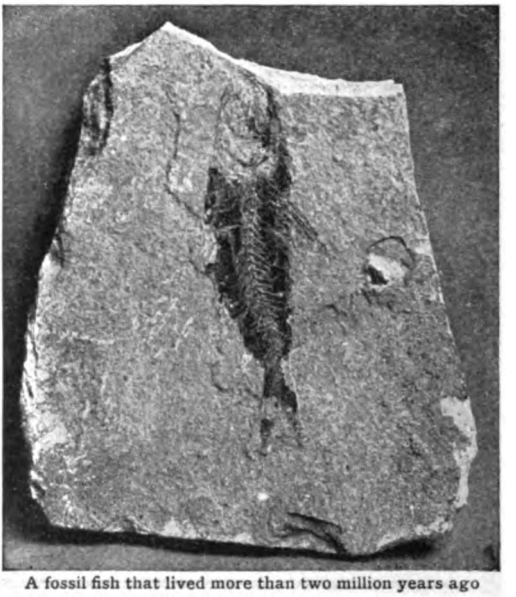
Below this are also fishes, including the first vertebrates, or back-boned animals.

Lower still are various shell creatures, and seaweeds, of thirty million years ago.

Finally, we have the first traces of living creatures; with the hard rocks formed by fire, lowest of all.

them in order to get a view of what they teach us regarding life; but many accidents and breakages have happened, so that we find the layers mixed up in many places. We may find places where we come to layers of quite another kind, and where there has actually been a crack, on one side of which the earth has been heaved up, or has fallen down. When men are seeking coal, or gold, or something of the kind under the ground, it is very annoying to come to places like this. They are called "faults" by men who study geology.

But such places teach us something of what an earthquake means, and terrible instances like the Italian earthquake show us that, from these cracks and violent disturbances of the earth's crust, large consequences may follow. It is possible, for instance, that Sicily, in consequence of an earthquake like that which has recently taken place, may become joined by dry land to Italy. We may say that this looks like a contradiction of what we began with—the great lesson that the earth's history is made by small things. But what makes the earthquake? It is the small, slow, sure processes that are always going on. We live on a hot ball, the interior of which is slowly losing its heat and shrinking. The crust which is supported on this interior is constantly having its support drawn away from under it. So it must fall and follow. When an apple shrinks, the skin must follow, and so the skin becomes wrinkled. It is possible that mountain ranges are in part produced by this wrinkling of the earth's skin as the interior shrinks. Also the crust gives way at various places. It may do this very suddenly, just as a steel rod may give way all in a moment, though it does so because it has been slowly rusting for months. Hence the earthquakes that produce great results very suddenly are themselves the results of the slow age-long forces which really make the history of the earth's crust. As these forces go on working, the crust may seem to rise or sink here or there; water and dry land change places, sometimes in a moment — the disappearance of an island has actually been photographed—but more often by processes that leave no outward sign save in hundreds of years. If there is any one idea that we should have in our minds and always keep there about the earth's crust and the whole science that is called geology, it is that geology is not simply a record of a past process that has now come to an end, but that the forces which have made the past history of the earth are still at work. We are in a stage, just as creatures that lived five or ten million years ago were in a stage. They were on the surface then, we are on the surface now. Boston has more than once been at the bottom of the sea and will doubtless be there again. There is nothing permanent in boundaries or frontiers, whether made by water or by mountains. The one thing that may outlast the United States or the Himalayas is the human mind, and the truths and beauties that it can discover and imagine. These are the only kind of legacy that we can hope to hand to remote ages of men, who may live on some new continent now beneath the waves, and may sail in their ships over what once was Britain, but will still know and honour the names of Shakespeare and Milton and Newton and Harvey and Darwin.



A fossil fish that lived more than two million years ago

The next part of this is on page 3003.

READING

WORDS USED IN THE PLACE OF NOUNS

CONTINUED FROM 2655

So far we have only learned two kinds of words. First, words that are names of people or things, like BOY, DUCK, KING, SHEPHERD; and, second, words that tell us something about people or things, like GOOD, TALL, BLACK. Do you remember what these two kinds of words are called? It does not matter very much whether you remember or not, as long as you know the difference between these words when you see them. But when you grow up and go to school (though, perhaps, you do go to school already) you will have to learn to call the first kind NOUNS, and the second kind ADJECTIVES.

Now let us pretend again. Suppose someone came to you and said: "Please tell me a story—tell me a story about BOYS and GIRLS and FAIRIES and WOODS and LIONS and TIGERS and CAKE and GINGERBREAD and INDIANS, and all sorts of things." Now, how would you begin to tell a story that would please the person who asked you? Well, of course, you would begin with "Once upon a time," or else it would not be a proper story. And then you would go on something like this: "Once upon a time there lived a little boy, and HE had a little sister. SHE was always happy when SHE was playing with HIM, and THEY used to have such jolly times together. One day THEY went into a wood WHICH was behind their father's house. Now, the wood was full of lions and tigers and Indians, and all sorts of awful things; but the good fairies took the brother and sister by the hand and led THEM along quite safely, till THEY came to a little house. What was their surprise to see that IT was made of cake and gingerbread, and all the windows were barley-sugar."

Now stop for a minute to take breath, and look back at the story that you are supposed to be telling. Do you see the little words that are printed in big capital letters? They are such little words, and yet they are very, very useful. Suppose there were not any of those little words; then see

how much longer and more clumsy the story would have been. You would have had to say something like this: "Once upon a time there lived a little boy, and the little boy had a little sister. The little sister was always happy when the little sister was playing with the little boy; and the little boy and the little sister used to have such jolly times together. (Is it not getting dreadful?) One day the little boy and the little sister went into a wood, and the wood was behind their father's house."

And so we should have to go on, using these long words over and over again instead of the nice short, easy ones that we used at first. Now, these little words, HE, SHE, IT, THEY, WHICH, are used instead of nouns, for nouns, and so they are called "for-nouns," only we like to seem clever and learned, and so we use the Latin word for "for," and that is PRO. So instead of calling them FOR-NOUNS, we call them PRO-NOUNS.

When I was at school I used to learn a little rhyme:

A PRONOUN is a word used instead of a NOUN,
As, James was tired and HE sat down.

But I like the next one better, because it is less like a grammar book:

HE, SHE, IT went out to tea,
And ate of tea-cakes not a few:
When asked their names, said, "WE are WE.
As sure as YOU are YOU."

HE, SHE, IT had cousins too,
But did not take them out that day:
When asked, "How do your cousins do?"
Replied, "Oh, THEY are THEY!"

WRITING

CAPITAL I, J, C, E, AND G

"We know fifteen letters, mother," said Nora, when she and Tom next sat down to their writing lesson. "That is more than half."

"And I hope we shall learn five more to-day," replied her mother. "Small i was easy to make, and capital I is easy. In writing letters to friends we often want to use it, for most letters have I in them somewhere; so we must make it well."

"Let the pen start making the loop between the two lines; bring it lightly round and up to the right, and then make a heavier down-stroke like that of T or F, or the first part of H or K. Now, Tom, see which of those four letters is most like I."

Tom looked at all five letters, and soon saw that T with the turn, not T like the T-square, was most like I.

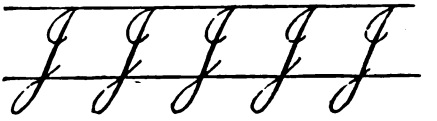
"But," said he, "T has a turn, and I has a loop. How can we remember, Nora?"

Nora put on her thinking-cap, and puzzled over it, till, happening to look down at her sleeve, she noticed a hook fastening it at the wrist by a loop made of cotton, not by an eye.

"Yes, Nora; that's it!" exclaimed her mother. "The eye has a loop."

"Now we shall know," said Tom, as he looked at Nora's sleeve, and saw that the loop bulged out like the curve of I from the down-stroke.

After practising the loop of I, the children were shown how to make its brother letter, a grown-up brother letter, as the children soon discovered.



"I has been growing a tail. Look! A tail like that of Y and Z."

Nora and Tom looked, and asked what the letter was.

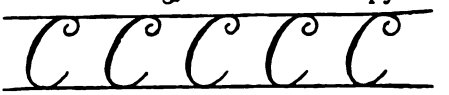
"Cousin Jack's letter," said their mother. "What do you think 'Jack' should begin with?"

Nora thought it must be J, because it sounded so like it, and she was quite right.

"And J comes next to I in the alphabet, you know, Nora," said Tom.

"You can think of I grown up into J with a tail," observed his mother. "There is a bird called a jay, which learns to talk like a parrot. As it has

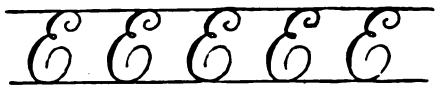
a tail, too, that will help in remembering J's tail. Here is a letter easy to recognise. What is it ? " she asked, when the children had finished J, and she was writing C for them to copy.



Tom and Nora had hardly need to do more than glance at it. They knew it must be C, because it was so like little c, only, as Tom said, instead of starting at once with a little dot, it made a curled-up little tail to look more important, for it had to do something to show it was not a little c, but a big one.

Their mother said they must make it double the height of the little letter c, so that then it could not be confused with the small letter.

" Now," she said, when the children had finished writing it, " the next letter is a pretty one, full of curves, but it needs special care to make because it has so many turns. It is E."



" What is the figure which is the same as a stroke, Tom ? "

Tom answered " 1," and his mother, holding up a piece of looking-glass so that E was reflected in it, asked, " And what is this ? "

" Why, mother, it is a 3 ! " exclaimed Nora. " But only in the looking-glass," she added, as she and Tom began to copy their mother's letters.

They were shown how the upper curve started on the right below the upper line, went up and round to the left, and round and down to the right, and then repeated a bigger curve under the upper one, so that it had a curve above and a curve below. It wanted care to make the upper and lower parts nicely rounded, but when Tom and Nora had practised making it they were shown the fifth letter, G. Here it is :

" G " said their mother, " begins in the same way as E, but makes a bigger loop, and ends quite differently by a down-stroke which curves round to the left and ends in a dot. There is another way of making it, but this one is simple. Look at it well before beginning."

Tom and Nora knew by this time that if they did not look carefully first they were very likely indeed to make mistakes, so they had a good look at G before they set to work to copy it.

ARITHMETIC

THE WAY TO MULTIPLY BIG NUMBERS

ALTHOUGH we have learned to speak of " multiplying a number by 3," we must always remember that this is simply a short way of saying that we " add together three equal numbers." In writing the problem we write the number itself *once*, and the *multiplier* shows how many of these numbers we are adding together.

If I have 5 bags, and each bag contains 136 nuts, how many nuts have I altogether ?

Here we have to find what the result would be if we wrote the number 136 five times, and added the five numbers together. To find this, we write 136 only *once*, and the *multiplier* 5, written under the unit's figure of 136, shows that we are adding *five* numbers, each of which is 136. Let us work it.

136	Say, five 6's, 30; put down
5	0, carry 3. Five 3's, 15, and
—	3, 18 ; put down 8, carry 1.
680	Five 1's, 5, and 1, 6; put down 6.

Multiplication by any of the numbers from 2 to 9 is done in the same way as the examples we have already worked. We ought not to find any difficulty about it, since the process is just like addition : we find first what the units make, then the tens, and so on.

We now come to another important point. Suppose 4 children have 5 apples each. Altogether, there will be 4 times 5 apples. Next, if each of the children gives one of his apples to a fifth child, they will each have 4 apples left, and the fifth child will also have 4 apples.

Thus, we now have 5 children each with 4 apples, so that, altogether, there are 5 times 4 apples. But, in all, there are just as many apples as there were before; so it is clear that

"Five times 4" is the same as "4 times 5."

The use of knowing this is seen in a question like the following:

A blacksmith uses 7 nails to fasten a horse-shoe. How many nails will he use to fasten 248 horse-shoes?

Evidently he will require 7 nails 248 times—that is, we want to know how many 248 times 7 make. At present this would perhaps be difficult to us; but when we remember that "248 times 7" is the same as "7 times 248" it is quite easy, because we know how to multiply 248 by 7. If we work this, we find the blacksmith requires altogether 1736 nails.

Examples

1. A market-gardener plants 254 cabbage-plants every day for 6 days. How many is that altogether?

2. Two hundred and fifty-seven boys each do 8 lines of writing. How many lines do they do altogether?

3. Forty-three girls have 5 pennies each, and 29 boys have 7 pennies each. How many pennies is that altogether?

First find how many the girls have, then how many the boys have, and add the two numbers together.

4. Multiply seven thousand two hundred and nine by nine, and write out the answer in words.

5. If 243 boys each have 3 marbles in one hand and 4 in the other, how many marbles have the boys altogether?

Let us multiply the number 34 by 10. If we use the same method as we have done for the numbers up to 9, we shall have:

34	Ten 4's, 40, carry 4.
10	Ten 3's, 30, and 4, 34.
340	

So that the answer is 340.

Now, 340 and 34 are very much alike. They each have a 3, followed by a 4. Then one of them has 0 following the 4.

Suppose we try to find the reason these numbers are so much alike.

	3	4

Using our "boxes" again for a while, the number 34 means that we have 4 things in the right-hand, or units, box, and 3 bundles of them in the tens box. Now, if we multiply this number by 10—that is, if we add together ten 34's—each "one" becomes a bundle of ten, each "ten" becomes "ten bundles of ten," or what we call a hundred. Thus, instead of 3 tens and 4 ones, we have 3 hundreds and 4 tens. Putting these into their proper boxes, we get a 3 on the hundreds box, a four on the tens box, and a 0 on the units box.

3	4	0

We see, then, that *to multiply a number by 10 we have only to put a 0 at the right of it.* For this means that the figure which stood for "ones" now stands for "tens," the figure which stood for "tens" now stands for "hundreds," and so on—that is, the number is ten times what it was.

For example, 5894 multiplied by 10 is 58940.

320 multiplied by 10 is 3200.

ANSWERS TO EXAMPLES ON PAGE 3132

MUSIC

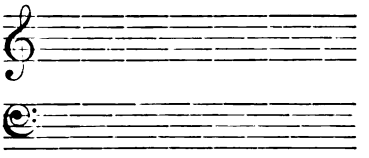
THE MAP WHICH THE FAIRIES MADE

We now know where all our fairies and goblins live; we know their names, and we know how to make each one sing his or her little song; but sometimes two, or three, or four, or even more want to sing together.

And long ago the question arose in fairyland: "How can we make it possible for the children to see at a glance how to press down two, three, four, or even more of our little notes at the same time?"

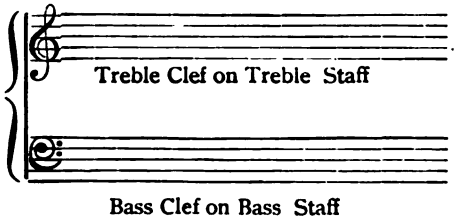
At last one of the little goblins spoke words of wisdom, and this is what he said: "Fairies and goblins all, we know that the Treble Road and the Bass Road appear as one very long line to the child who comes to see us in our magic kingdom, the piano. To look all along that line in a passing second of

time would be very difficult, and many signs would be wanted to show that those of us in the Treble Road are wanting to sing with our friends in the Bass Road. The only easy thing to do is to give everyone a curious sort of map, which we in fairyland know how to make. It will look as if the Treble Road were over the Bass Road, and as if the Bass Road lay under the Treble Road, just like this :

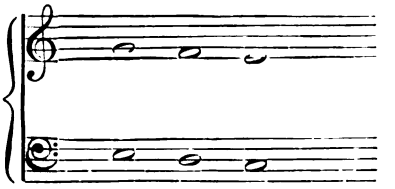


"Of course, as you see, Treble Clef must stand at the entrance of the Treble Road (or Treble Staff, as we know it is called), and Bass Clef must take up his stand at the entrance of the Bass Road. To show there is a reason for this curious map, and to tell the children of earth that the fairies and goblins in each road are going to give beautiful choruses instead of little solos, we must give them a new sign, like this : { It joins the roads together, and the children of men will call it a *brace*. So will they know that they must be clever enough to use two hands, and approach different notes with them at the same time."

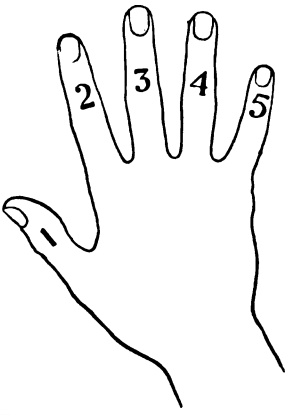
All the fairies and goblins thought this was a very clever idea, and they clapped their little hands, and fluttered their small wings, so that all who had "fairy ears" heard the most beautiful music, so exquisite that we can hardly imagine how really wonderful it was. This is the fairy map which has been made for you and me :



If we wait a little while longer, we shall see the fairies have taken up their places on the lines and in the spaces. Yes, here they are :

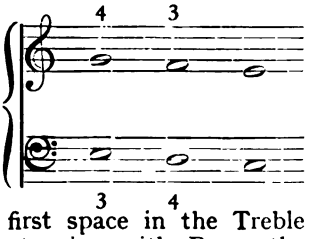


You see, Fairy G on the second line in the Treble Road and Fairy E in the third space in the Bass Road want to sing together ; so find Fairy G with the fourth finger on your right hand, and Fairy E with the third finger on your left hand, then press down very firmly, but gently, *quite together*, and we shall hear how nicely their voices blend. In case you are a little puzzled about the fingers of your hand, there is a picture on this page with the fingers all marked, so that it may be quite easy to make no mistakes.

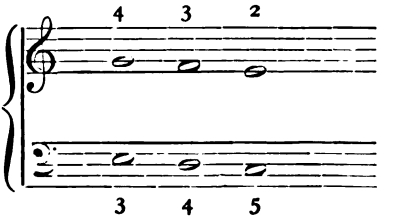


This is how we number our fingers

Now we look at the next two notes :



F in the first space in the Treble Road wants to sing with D on the third line in the Bass Road. Again we must find our fairies, and we want the third finger on the right hand and the fourth finger on the left hand ; but we must approach them carefully, mind that they sing exactly together, and I know we shall think how very nice they both are. Just two more fairies left, and they are very anxious for us to hear them :

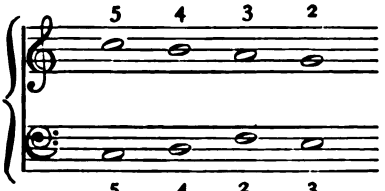


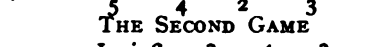
Fairy E on the first line in the Treble Road, waiting for the second finger of the right hand; Fairy C in the second space in the Bass, waiting for the fifth finger of the left hand.

Do you not think it would be nice to play one or two games like this last one, so that we can see how quickly fairies can be found, even when they live in different roads, and how little time we need lose in thinking which fingers we want to use?

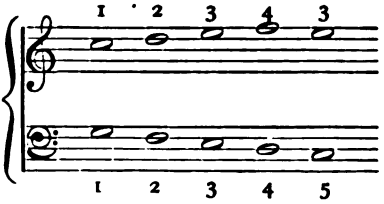
The merriest way to play our game is to make up our minds to find fairies and fingers by the time we have counted four, taking care to find the right ones.

THE FIRST GAME





THE SECOND GAME

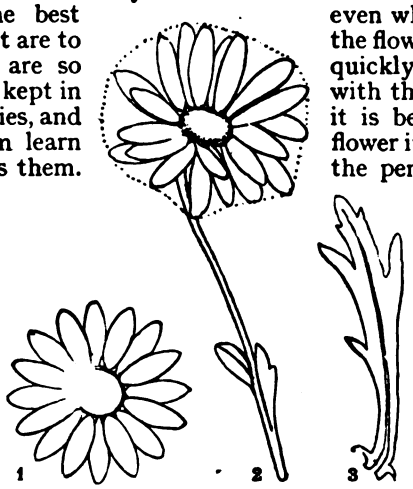


DRAWING

DRAWING AND PAINTING A DAISY

Now that we know something about colour and a little about pencil outline from plants, and about designing or making patterns, we will try and use all these together. We must remember that it is best to take simple things to copy, and to use only a few colours till we have grown clever with brush and pencil. It is better not to copy anybody else's drawings till we are big enough to go to places where only the best pictures and the best sculpture and ornament are to be seen; these things are so valuable that they are kept in museums and art galleries, and people who copy them learn a great deal that helps them.

The great artists who did this wonderful work were once little children who found straight lines and curves very difficult, and sometimes so tiresome that they felt inclined to give up. But they would not let themselves be beaten; they drew the things they saw all around them every day, taking the easy ones first, till they made pictures at which thousands of people still love to look, as they hang on the walls of our picture-galleries.



Pictures 2 and 3 show the daisy drawn from nature; 1 gives the "conventional" drawing.

Let us get a flower with its leaves and buds, and our paints, and white and brown paper. We will try to copy the flowers first, using white paint for the flower and black for the leaves and stalks, painting it in as many different positions as possible. If we like, we can do it all in black paint on white paper, just to get an idea of the flower.

Flowers and leaves change so quickly that we have to work partly from memory even while we are looking at the flower. We can work more quickly with the brush than with the pencil; that is why it is best to get to know the flower in brushwork first. For the pencil drawing, we must sketch in the general outline first, and not alter this at all till we come to finishing the drawing with a clear outline. If the flower changes so much that we cannot finish the first sketch, we must begin another.

Suppose we have managed the general outline — as it is shown in the dotted line in the illustration—sketching it in with the chisel-pointed pencil; we can then put in the yellow centre. Unless we are looking full at the flower, the

circle in the centre will alter as the jam-jar did; it will be oval—narrower as it comes near the level of the eye. The general outline has been drawn round the points of the white rays, which are also set in a circle, and this will narrow or widen as the centre one did, according to its nearness to or distance from the eye-level.

We will put in the principal white rays first, and then the others. Some are behind each other; some look shorter than others. We must look at each one carefully first before we draw it.

As soon as we have made a nice drawing, we can rub out the working lines, and put in the lines we want to keep with a sharp-pointed pencil to give a good, clear outline. The lines for the stalk, the leaves, and the centre should be stronger than those for the white rays, but none of them should be heavy.

Now let us put all our drawings and the flowers away, and do some others from memory; then we can see how much we have remembered. Afterwards we will make what are called "conventional drawings" of the flower and leaves and buds. We get our idea from Nature, but we make rather stiff drawings with both sides alike, for we want this sort of drawing for decoration. In the ivy leaf we found a five-cornered shape. The proper name for that shape is pentagon, which means five corners. The daisy has a circle for its conventional shape. It looks nice in the middle of a square; but the corners must be filled up with leaves or buds, so that if the square outline were taken away we could still see that the pattern was meant for a square. Let us draw a little square tile, with each of its sides three inches long, and put a circle for the daisy of one inch and a half radius in the middle. We find the middle of a square by drawing lines from corner to corner. Then we can put in the daisy and leaves in the spaces, and paint the tile in three colours—yellow, orange, and green, leaving the flower of white.

Some positions in which we see the daisy

As the flower is to be left white, the background must be painted. This is the most difficult part of the painting, and must always be done first; great care must be taken to keep the wash of colour quite flat and to keep the edges of the pattern clean. We must remember that perfection only comes with practice, and that, though it is difficult, it can be done very nicely even by quite little children. We must keep trying, and take every chance we can of going to places where we can see other people's work, and if other little girls and boys are doing this drawing too, it will help us both to see each other's work, for we learn much by the mistakes of others.

The daisy and its leaves

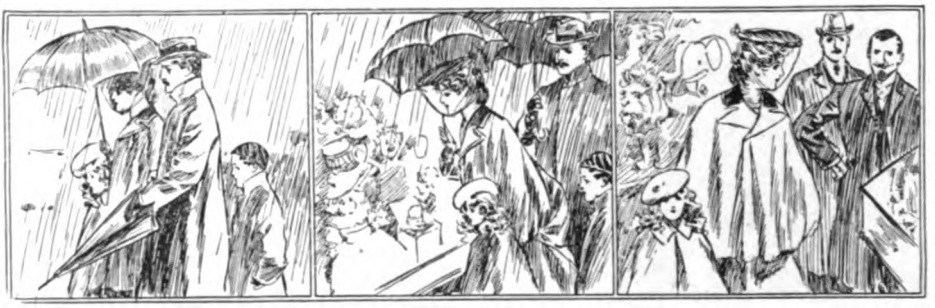
LITTLE PICTURE-STORIES IN FRENCH

First line: French. Second line: English words. Third line: As we say it in English.

It pleut. Nous irons acheter des cadeaux pour les prendre chez nous.
It rains. We shall go to buy some presents for them to take to the house of us.
It is raining. We are going to buy presents to take home

Nous trouvons nos parapluies, et nous sortons. Nous traversons la rue.
We find our umbrellas, and we set out. We traverse the street.
We find our umbrellas, and start out. We cross the street.

Il y a un magasin dans la prochaine rue où l'on vend de beaux joujoux.
It there has a shop in the next street where (the) one sells some beautiful toys.
There is a shop in the next street where they sell beautiful toys.



Nous entrons tous. Le commis dit: "Qu'est-ce que madame désire?"
We enter all. The shopman says: "What is this that madam desires?"
We all go inside. The shopman says: "What can I do for you?"

"Nous désirons acheter des cadeaux. Combien coûte cette poupée?"
"We desire to buy some presents. How much costs this doll?"
"We wish to buy some presents. How much is this doll?"

"Quinze francs, madame." "C'est trop. Montrez-moi d'autres poupées."
"Fifteen francs, madam." "That is too much. Show me some other dolls."
"Fifteen francs, madam." "It is too much. Show me some others."

"Puis-je avoir celui-ci dans la robe bleue pour la cousine Elsie?" dit Jeannette.
"May I to have this here in the robe blue for the cousin Elsie?" says Jenny.
"May I have this one in the blue frock for cousin Elsie?" says Jenny.

Nous achetons la poupée, et je choisis des soldats pour mon ami Jean.
We buy the doll, and I choose some soldiers for my friend John.
We buy the doll, and I choose some soldiers for my friend John.

Puis nous choisissons des chaises pour la maison de poupées d'Annette.
Then we choose some chairs for the house of dolls of Annette.
Then we choose some chairs for Annette's dolls' house.

"Il fait du soleil," dit Jeannette. "Allons nous promener."
"It makes of the sun," says Jenny. "Let us go ourselves to promenade."
"The sun is shining," says Jenny. "Let us go for a walk."

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